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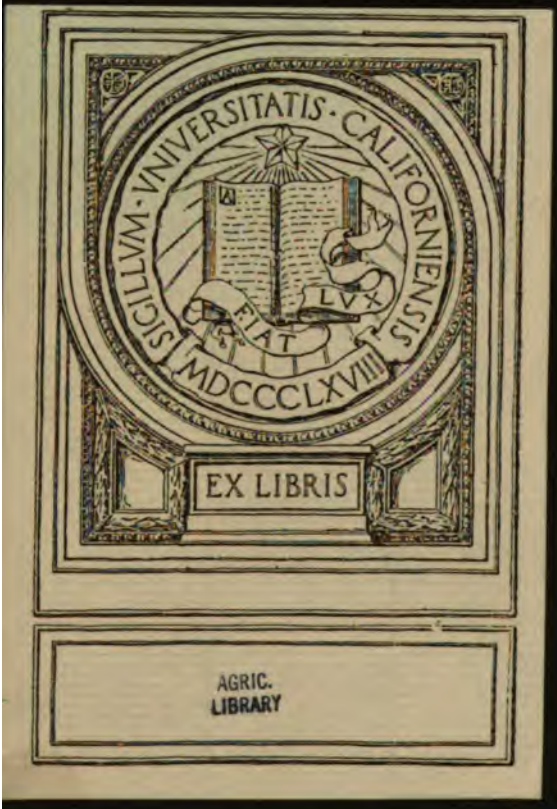

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INSULAR EXPERIMENT STATION

RÍO PIEDRAS, P. R.

ANNUAL REPORT

OF THE

INSULAR EXPERIMENT STATION

OF THE

DEPARTMENT OF AGRICULTURE AND LABOR

OF

PORTO RICO

FISCAL YEAR 1919-20

SAN JUAN, P. R.

BUREAU OF SUPPLIES, PRINTING, AND TRANSPORTATION

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Government of Porto Rico

DEPARTMENT OF AGRICULTURE AND LABOR

Insular Experiment Station

Río Piedras, P. R., *August 14, 1920.*

Honorable Manuel Camuñas,

Commissioner, Department of Agriculture and Labor,

San Juan, P. R.

Sir: I have the honor to submit herewith the report of the activities of the Insular Experiment Station for the fiscal year ending June 30, 1920. The present manuscript constitutes the tenth annual report of the agricultural work conducted by this Station.

Respectfully,

E. D. Colón,

Director.

Approved for publication:

Manuel Camuñas,

Commissioner.

REPORT OF THE DIRECTOR.

UNIV. OF CALIFORNIA

PART I.—ADMINISTRATIVE.

LEGAL DEVELOPMENTS.

Two sessions of the Legislative Assembly of Porto Rico have been held during the fiscal year 1919–20. The regular session convened in February of 1919 and the extraordinary session in May, 1920. Below are given the titles of the acts and resolutions thereby approved which have a bearing on the agricultural work of the Insular Experiment Station or other branches of the Department.

REGULAR SESSION, 1919.

Act. No. 17.—To Prevent the Introduction into Porto Rico of Plant Diseases and Insect Pests, and for other purposes.

Act No. 18.—To Regulate the Registration and Inspection of Commercial Fertilizers, Fertilizing Substances and Substances for Amending the Soil in Porto Rico.

Joint Resolution No. 2.—Authorizing the Commissioner of Agriculture and Labor to Appoint an Inspector to Assist the Chief Forester of Porto Rico in the Inspection Service.

Act. No. 71.—Making Appropriations for the Necessary Expenses of Carrying on the Government of Porto Rico for the Fiscal Year ending June 30, 1920, and June 30, 1921, respectively, and for other purposes.

Act No. 82.—To Amend Act No. 71, given above.

EXTRAORDINARY SESSION, 1920.

Act No. 3.—For the Incorporation and Regulation of Cooperative Associations of Production and Consumption.

Act No. 11.—Providing an Additional Compensation for Officers and Employees of the Insular Government over and above their Salaries, and for Expenses for the High School of the University of Porto Rico and the San Juan High School, during the Fiscal Year 1920–21.

Act No. 16.—To amend the Antepenultimate Paragraph of Section 1 of Act No. 71 Entitled "An Act Making Appropriations for the Necessary Expenses of Carrying on the Government of Porto Rico for the Fiscal Year ending June 30, 1920, and June 30, 1921, respectively, and for other purposes," approved June 20, 1919.

PERSONNEL.

The resignations, appointments and promotions occuring during the year 1918 to 1920 are given below in tabular form. The duration

of service is given in the last column. The movement of personnel in 1918–19 is here given because of its influence on the 1919–20 work.

Movement of Personnel, Fiscal Years 1918–1920.

Position	Filled	Vacated	Appointee	Duration of service
Director [1]	(Note 1.)	(Note 2.)	E. D. Colón	24 months.
Expert in Plant Diseases	July 10, 1919	(Note 2.)	F. S. Earle	10 months, 20 days.
Chief Chemist [1]	(Note 1.)	(Note 2.)	F. A. López	24 months.
Assistant Chemist	July 1, 1918	Sept. 14, 1918	I. A. Colón	2 months, 13 days.
	Nov. 4, 1918	(Note 2.)	J. H. Ramírez	19 months, 26 days.
Assistant Chemist	July 1, 1919	Sept. 14, 1919	I. A. Colón	2 months, 13 days.
	Sept. 16, 1919	Jan. 7, 1920	R. Vachier	3 months, 21 days
	Mar. 9, 1920	(Note 2.)	Ismael Colón	3 months, 1 day.
Asst. Chemist for fertilizers	July 1, 1919	(Note 2.)	R. Vilá Mayo	11 months, 29 days.
Chief Pathologist [1]	(Note 1.)	Dec. 16, 1918	J. A. Stevenson	5 months, 15 days.
	Jan. 1, 1920	(Note 2.)	J. Matz	5 months, 29 days.
Assistant Pathologist	Dec. 12, 1918	Jan. 1, 1920	Julius Matz	12 months, 19 days.
Assistant Pathologist	Dec. 10, 1918	(Note 2.)	B. López	18 months, 4 days
Chief Entomologist	Dec. 26, 1918	(Note 2.)	E. G. Smyth	18 months, 20 days
Assistant Entomologist	Dec. 12, 1918	Apr. 12, 1919	Edgar Nelson	4 months.
Assistant Entomologist	July 1, 1918	Aug. 31, 1919	M. A. Crespo	13 months, 21 days.
	Sept. 2, 1919	(Note 2.)	L. A. Catoni	9 months, 28 days.
Chief Agronomist	Aug. 14, 1919	Nov. 24, 1919	J. H. Wale	3 months, 10 days.
	Jan. 1, 1920	(Note 2.)	E. E. Barker	4 months, 29 days.
Plant Breeder	(Note 1.)	July 6, 1918	H. B. Cowgill	6 days.
	Apr. 26, 1919	July 9, 1919	F. S. Earle	2 months, 4 days.
	July 21, 1919	Dec. 31, 1919	E. E. Barker	5 months, 10 days.
	Mar. 1, 1920	(Note 2.)	P. Richardson	4 months, 9 days.
Horticulturist	July 1, 1918	July 19, 1919	I. L. Torres	12 months, 18 days.
	Aug. 5, 1918	Oct. 8, 1918	P. González	2 months, 3 days.
	Nov. 7, 1918	(Note 2.)	P. González	7 months, 23 days.
Veterinary Inspector	July 1, 1919	(Note 2.)	J. Bagué	11 months, 29 days.
Quarantine Inspector	Sept. 1, 1919	(Note 2.)	M. A. Crespo	9 months, 29 days.
Asst. Quar. Inspector	Apr. 17, 1918	(Note 2.)	W. V. Tower	26 months, 13 days.
Asst. Quar. Inspector	(Note 1.)	Aug. 31, 1919	J. J. de Barril	13 months, 30 days.
	Sept. 1, 1919	(Note 2.)	E. Pasarell	11 months, 29 days.
Asst. Quar. Inspector	Dec. 6, 1918	July 31, 1920	V. Soler	*
Librarian	Sept. 1, 1918	Nov. 18, 1919	C. Horton	14 months, 17 days.
	Dec. 9, 1919	Apr. 26, 1920	E. Torres	4 months, 17 days.
	May 26, 1920	May 31, 1920	I. Paganacci	5 days.

Average duration of service during the two-year period — 10 months, 4.3 days.
Time lost out of 24 months on account of vacancies — 13 months, 25.7 days.

No excuses are offered for ushering the year's report with a discussion of the personnel and a tabulated account of its succession and duration of service. If there be only one important business in the activities of our experimental station, that one important business would be the obtaining and retaining for it the services of the right kind of employees.

It is apparent from the above record that there has been occasion for thought and effort in connection with the personnel of the Insular Experiment Station. As early as June, 1918, the Director officially

[1] Appointed before July 1, 1918. Computed from July 1, 1918.

[2] When not vacated, duration of service has been calculated up to June 30, 1920.

* Not included in computations, since his term of service has extended throughout the cane season only.

presented the personnel question confronting the institution and referred to the "man" factor as decisive in scientific work. In April, 1920, and apropos of a recommendation for a raise in salaries, the Director expressed himself in the following terms:

"These lapses (vacancies in positions) are of course harmful, not only because while they last the service is proportionately paralyzed, but more so because each one of them ends with the appointment of a new man with a personality, inclinations, and aptitudes different from the person whom he is going to substitute. Consequently, many investigations already started are necessarily not handled with the same interest, they gradually lose in intensity and have at last to be closed without due completion. New problems are, then, taken up which carry along with them new outlays of money and, naturally, the loss, partial or total, of the investments made in the discontinued investigations."

"After due reflection and putting it briefly, it would not be *an expense* but *a saving* for 'The People of Porto Rico' to remunerate its necessary positions in such a fashion as to induce capable parties to accept them and retain them at least long enough for their efforts to bear fruit."

In the same document the position was taken that, were the Treasury short of funds for a general increase, there was only one remedy left—which was resolutely advocated: the abolition of positions of secondary importance so that the primarily important ones could be given the necessary remuneration. Flexibility in the salaries—within the range of a maximum and a minimum if desirable—was also advocated, the practice in the University of Porto Rico being cited as a precedent.

This attitude is embodied in the following desirable measures:

1. The increase of the total sum for salaries or,

2. The reduction of the personnel without reducing the total appropriation for salaries.[1]

3. The non-stipulation by the Legislative Assembly of the salaries of the technical employees of the Station, so that important positions may be filled by men who, on account of their training, experience and temperament, will not take long to mature and present to the public of Porto Rico the fruit of their labor.

In June, 1919, the Legislature approved its Act No. 71. By it salaries below a certain maximum received an increase. A further increase for the year 1920–21 was granted by the Legislative As-

[1] This very same attitude was put into practice during 1919–20 by the Department of Education of Porto Rico when it abolished the University High School at Río Piedras and made use of the funds thus released to increase the pay of the University professors.

sembly in its extraordinary session of February, 1920, in response to the cry for higher wages to meet the soaring cost of living.

These advances in salaries have not, in the majority of cases, attained the minimum level required by professional men for their services. So, at present, the problem stands.

APPROPRIATIONS.

A statement of the disbursements and balances in our appropriations for the fiscal year 1919–20 is given below as it stood on August 31, 1920:

Name of appropriation	Amount of appropriation	Payments made	Amount due and unpaid (estimated)	Balance
Salaries	$44,252.00	$37,573.44	----------	$6,678.56
Farming expenses	6,000.00	5,971.30	----------	28.70
Traveling expenses	2,500.00	2,391.10	----------	108.90
Printing and stationery	1,500.00	898.12	$321.00	280.88
Incidentals	1,000.00	562.42	----------	437.58
Equipment and accessories	4,500.00	3,015.58	1,581.22[1]	—96.80[2]
Postage and freight	400.00	397.65	----------	2.35
Telegraph and telephone	250.00	140.72	45.62	63.66
Lighting and water	800.00	338.13	----------	461.87
Motorcycle repairs	100.00	----------	----------	100.00
Maintenance of buildings	300.00[3]	300.00	469.80	330.20
Maintenance of roads	300.00	300.00	299.93	.07
Care of cattle	1,000.00	678.85	160.85	160.30
Eradication of ticks	15,000.00	9,713.03	465.18	4,821.79
Purchase of specimens of caprine, ovine and porcine cattle	5,000.00	2,936.62	500.00	1,563.38
Total	$82,902.00	$65,216.93	$3,078.87	$14,611.17

[1] Estimated cost of requisitions chargeable to the appropriation "Equipment and Accessories.

[2] Due to the growing increase in the cost of supplies, many bureau bills were received exceeding the estimated cost in our requisitions, this being the reason for the "deficit."

[3] A further allowance of $500 was made to the Station by the Department of the Interior.

Salaries.—Over six thousand dollars remained unspent due to the impossibility of filling the positions of Assistant Entomologist at $1,890, Assistant Pathologist at $1,890, and to temporary vacancies in several of the others.

Farming Expenses.—The outlay for farm labor in connection with the crops grown and animals raised at the Station has, during the fiscal year 1919–20, been as follows:

Crops	Acreage	Total labor expense
Sugar cane	58.38	$3,718.43
Pineapples	.67	71.55
Bananas	1.57	31.86
Rice	.16	16.75
Grapefruit	1.51	1.50
Mangos and avocados	2.00	83.49
Sisal	2.00	31.72
Elephant grass	1.50	19.69
Sweet potatoes	3.87	131.42
Peas and beans	2.66	*
Coffee seedlings	.25	20.17
Corn	.50	5.75
Cowpeas	.75	17.18
Velvet beans	1.00	9.51
Papaws		2.45
Pastures	27.63	198.42
Meadows	21.34	
Nursery	1.00	1,153.57
Park	10.00	
Miscellaneous expenses:		
Park		79.52
Fences		202.69
Bridges		5.50
Stabling		20.81
Stores		25.84
Greenhouse work		22.25
Carting		40.87
Other work		60.36
Total	136.79	$5,971.30

Traveling Expenses.—The total mileage covered and days spent for travel by the staff of the Station during the year has been 13,497 miles and 221¾ days respectively. Their distribution among the divisions is as follows:

	Miles	Days
Director and Acting Director	2,056	28.50
Expert in Cane Diseases	2,659	52.50
Division of Pathology	1,405	31.00
Division of Agronomy	1,343	45.75
Division of Chemistry	354	26.50
Division of Entomology	165	5.75
Veterinary Inspector	3,134	26.50
Quarantine Inspector	535	6.00
Total	11,651	222.50

The total expenses was two thousand nine hundred and seventy-one dollars and ten cents ($2,971.10).

* "Medianeros" ("halvers"); no expenses.

Printing and Stationery.—The balance of $280.88 is misleading. Delay in the releasing for the press of Vol. IV, No. 2, of *The Journal of the Department of Agriculture of Porto Rico*, and of Bulletin 23, *"Plant Inspection and Quarantine Report (1918–19),"* alone has made a surplus possible. On the contrary, the appropriation is not sufficient to take care of the printing and stationery expenses of the Station. So much so that during the year all publications connected with the cattle-tick eradication campaign and all expenses connected with the yellow-stripe disease of cane have been met out of the fund for the eradication of the cattle tick and the Trust Fund respectively. Furthermore, the sum of $1,000 had to be secured by the Director to take care of the expenses in the publication of twenty-five circulars in Spanish for popular information of the farmer. The appropriation should be substantially increased at the first opportunity.

Incidentals.—The unspent balance of $437.58, nearly 50 per cent of the whole appropriation, was deliberately saved for the reparation of one of the laborer's houses, as a question of emergency. At the last hour authorization for the use of that balance for the purpose was denied.

Equipment and Accessories.—The inadequacy of the appropriation made it necessary to obtain authorization for the payment out of the Trust Fund of expenses connected with certain services like the fertilizer service in the Division of Chemistry and the quarantine work, for which no special appropriations have been yet made by the Legislature. Tabulated below will be found a statement of the expenses in connection with the various divisions as they stood August 31, 1920.

Service	Payments	Bills pending (estimate)	Total expense
Division of Agronomy	$2,092.88	$993.00	$3,085.88
Division of Chemistry	124.98	424.35	549.33
Division of Entomology	110.68	123.75	234.43
Division of Pathology and Botany	157.27	----------	157.27
Library	358.15	28.61	386.76
Office	171.62	11.51	183.13

Postage and Freight.—Postage expenses during the year have been $200. Freight expenses, up to August 24, 1920, have been $197.65. Due to the impossibility of meeting all postage expenses out of this appropriation, authorization was requested and granted for the payment, out of the Trust Fund, of all postage for printed matter in connection with the yellow-stripe disease of sugar-cane and out of

the eradication-of-ticks fund of all postage for printed matter in connection with the cattle-tick eradication campaign.

Telegraph and Telephone.—The total annual (1919–20) expense for telegraphic service has been $15.60, and $125.12 for telephonic service, making a total of $140.72 all told.

Lighting and Water.—During the year the total charges for light have amounted to $35.20, for water to $52.45, and for gas to $250.48, making a total expense of $338.13. The $800 in the appropriation seem excessive. However, contemplated electrical installations in the chemical laboratory and new water installations for the animals have not as yet been made.

Motorcycle Supplies.—The appropriation is intact. The poor condition of the two motorcycle machines made it advisable not to throw any more money away on them. The machines will be condemned.

Maintenance of Buildings.—Section 7 of Act 82 of the Legislative Assembly of Porto Rico provides that all funds appropriated for such works in any department of the government shall be transferred to the Department of the Interior so that said department may carry out the works, as determined by the Organic Act. The sum thus transferred was $300, to which was added the sum of $500 apportioned by the Department of the Interior for repairs at the Insular Experiment Station. The total sum spent amounted to $469.80, leaving $330.20 unused.

As a rule, where any construction work has been called for, special concessions have been requested for the use of funds not otherwise available. The constructions completed at the Insular Experiment Station during 1919–20, the cost of their erection, and the fund utilized in each case are given below in tabular form:

Construction	Cost	Fund
Library building	$2,200.00	Trust Fund.
Watchman's house	None.*	
Dipping vat	454.14	Eradication of Ticks.
Fence for vat above	295.05	Eradication of Ticks.
Pig houses (10 in number) and enclosures	1,300.00	Trust Fund.

* Built from residual lumber from other constructions and reparations and at odd times by the watchman himself.

Maintenance of Roads.—Similarly, all road-construction work comes by section 7 of Act 82 under the jurisdiction of the Department of the Interior. The two short portions of macadamized road

leading from the two main entrances to the Station and measuring about 1,100 feet were built in 1910–11, this being the first appropriation ever granted this Station for road maintenance. A new mud roadway was also started from the mainway into an hitherto inaccesible portion of the farm. About 800 feet were completed last year. The total expense was $299.93.

Purchase of Cattle.—By Act 71 of the Legislature of Porto Rico, approved June 20, 1919, the sum of $5,000 a year was granted the Station for the purchase of milch goats, sheep and swine. This was done in response to and in lieu of a request to formally create in the Station a Division of Animal Industry, embodied in bills 192 and 202 introduced in the Lower House by Messrs. Morales Cabrera, Pesquera and Hernaiz.

Orders were placed in the United States payable out of this fund and importations made of Tamworth, Duroc Jersey and Berkshire swine; 2 pure-bred Toggenburg bucks and three 75 per cent pure Toggenburg does. A number of African woolless and common sheep were also acquired. Up to August 31 payments had been made to the amount of $2,936.62. There were bills pending estimated at $500. The estimated balance, $1,563.38, was intentionally unused, as explained below.

Care of Animals.—For the care of these animals only $1,000 a year were simultaneously appropriated by Act No. 71, referred to above. In the absolute impossibility of taking care with this sum of the installations, feed, medicines and labor consequent upon the acquisition of five thousand dollars' worth of high-priced animals, only a portion of that sum was utilized and a request for extra funds for the construction of the hog-houses, yards, and pens was made and obtained from the Station Trust Fund in the sum of $1,300. The fact that most of the animals were received late in the year, made it possible to reach the end of the fiscal year with the money available. What shall be done next year is a question.

Eradication of Ticks.—Fifteen thousand dollars per year for the years 1919–21 were appropriated by Act 71 of our Legislature to be used in a campaign for the eradication of the cattle tick in Porto Rico. The fund was available throughout the year for the construction of government vats, the purchase of the necessary materials for the solution to be used in these government vats and any other expenses occasioned by the launching and carrying out of the campaign necessary to get the people to build their own vats and dip their

cattle. Although there was a scarcity of solution materials and those available were being sold at excessively high prices, the fund was not available for the large-scale purchase and selling at cost by the Government of the necessary ingredients. The campaign was launched and carried out until February 29, 1920, by this Insular Experiment Station. At the request of the Director, the whole business was turned over to the Bureau of Agriculture as soon as the animal-industry work at the Station farm began to need the uninterrupted attention of Dr. J. Bagué, until then in charge of both activities.

Two tanks had been built for the Station by the Department of the Interior when our direct responsibility for the work ceased. Since then, the Station has lent every assistance to Dr. Varas of the Bureau of Agriculture who took charge of the work. The average approximate cost to the Government of the insular vats constructed by the Department of the Interior for the Department of Agriculture (the cost of 8 vats has been taken as a basis of computation) has been—

Materials	$276.56
Labor	215.67
Total	$492.23

General Income of the Insular Experiment Station.

TRUST FUND.

By section 4 of Joint Resolution No. 18, "To Organize the Services of the Insular Experiment Station of Porto Rico," approved November 30, 1917, there was created a trust fund to be known as "Sale of Farm Products, Trust Fund," to which would accrue any moneys received from the Insular Experiment Station from the sale of products obtained on the lands cultivated. These moneys were made "available, with the approval of the Commissioner of Agriculture and Labor, for the performance of work for improving and promoting the agricultural interests of Porto Rico, and principally for the study of prophylactic means that should be employed in order to prevent and avoid disease, the services of experts from other countries producing sugar-cane to be utilized if necessary."

By Act 71, "Making appropriations for the necessary expenses of carrying on the Government of Porto Rico for the fiscal years

ending June 30, 1920, and June 30, 1921, respectively, and for other purposes," the above provision was modified to read as follows:

"*Provided*, That all moneys received by the Insular Experiment Station from the sale of farm products, from the sale of animals, and any other income from whatever source coming to the Station, shall be deposited in the Treasury of Porto Rico in a trust fund to be known as 'General Income of the Insular Experiment Station, Trust Fund,' and shall be available for expenditure, with the approval of the Commissioner of Agriculture and Labor, in the performance of work for improving and promoting the agricultural interest of Porto Rico, and principally for the study of such prophylactic means as should be employed to prevent and avoid cane disease, utilizing, if necessary, the services of experts from other cane-producing countries; in the purchase of animals for useful purposes at the Experiment Station and in works for improving the breeds; in diffusing, by means of publications, all matters of interest and advantage to farmers."

A statement of the deposits by this Station in account with the Trust Fund during 1919–20 is summarized below:

	Receipts.
Sugar cane	$7,796.15[1]
Pineapples	24.05
Bananas	27.94
Grapefruit	4.95
Grass	1,100.91
Sweet potatoes	22.52
Reimbursements	530.76
Animals	118.00
Miscellaneous	35.98
Total	$9,661.26

CORRESPONDENCE.

The sum available for postage proved early in the year to be inadequate to take care of the increased volume of correspondence and number of outgoing publications, the Insular Experiment Station of Porto Rico not being eligible for the franking privilege enjoyed by the Stations of the States in the Union. Various requests for funds have been made and obtained on various occasions for the postage of several classes of publications; in such a manner, that mailing expenses for printed matter on the yellow-stripe disease are defrayed out of the Trust Fund; for matter connected with tick eradication, out of the tick-eradication fund; for a project for distribution of twenty-four circulars in Spanish, out of the Trust

[1] $2,448.66 should be added, which were deposited after June, 1920, making a total for sugar cane of $10,244.81 and $12,109.92 for total deposits for all crops during 1919–20.

Fund; and the remaining ones out of the ordinary appropriation for postage. Keeping track of these four stamp accounts is very annoying to say the least.

Below is given a tabular report of the correspondence handled through this Office during the year 1919–20.

LETTERS.

Letters received	3,175
Letters to be answered	2,121
Letters dispatched:	
Original	2,695
In response	1,552
Postage	$93.09
Letters unanswered	548
Answered from past months	277

PARCELS.

Parcels received	330[1]
Fertilizers and amendments	120
Insecticides, etc.	15
Soils and rocks	36
Plants for study	37
Parcels mailed	4,771
Postage	$134.16

LIBRARY.

Below is given a tabular report of the Library activities for 1919–20. The Station library originated as such in 1918 when the position of Librarian was created by our Legislature. Every effort has been made by the present director to develop this branch of the Station Service to its fullest extent, $386.76 having been devoted during the year to the purchase of books and equipment. It occupies now a building to itself in the Station grounds, the Librarian devoting his full time to its business. Although there is no special appropriation for its equipment, 31 subscriptions are being maintained and necessary purchases of works made every year from the general fund for Station equipment. The low salary assigned to the Librarian has been a great drawback in its progress, the average duration of service for the last two years having been 6 months, 13 days. For three months the service was absolutely at a standstill for lack of a good candidate. The salary should be raised so the services of the right person may be secured.

[1] 122 miscellaneous parcels received.

The total number of addresses in our Library mailing lists, for the distribution of publications, is at present 821, distributed as follows:

1. List of English exchanges	163
2. List of Spanish exchanges	57
3. Personal addresses (English)	191
4. Personal addresses (foreign)	46
5. Personal addresses (Spanish)	364
Total	821

PART II.—AGRICULTURAL.

OFFICIAL PROGRAM FOR WORK.

Retaining for convenience the grouping adopted in the annual report of this Station for 1918–19, the projects in the official program of work for 1919–20 are given below under each heading.

I. *Services in Compliance with Special Laws.*

1. Fertilizer inspection and analysis.
2. Plant inspection and quarantine.
3. Sugar-cane seed distribution.

II. *Investigational Services.*

Division of Agronomy.

1. Study of sugar-cane varieties.
2. Eyperiments with fertilizers for sugar-cane.
3. Experiments with fertilizers for pineapples.
4. Cultural experiments with varieties of bananas.
5. Improvement of tobacco.
6. Improvement of corn.
7. Improvement of rice with special reference to the upland types grown in Porto Rico.

Division of Chemistry.

1. Changes wrought in the grapefruit in the process of maturation.
2. An investigation of possible chemical changes in yellow-striped sugar-cane.
3. A study of the chemical composition of the filter-press cakes, the changes wrought in it by fermentation and of those materials that could advantageously be mixed with them with a view to their full utilization as a fertilizer material.
4. Chemical analysis of cane varieties.
   (Cooperative work with Division of Agronomy).

Division of Entomology.

1. White-grub investigations.
   (Final report on the *Dynastini* of Porto Rico.)
2. Investigation of the possibility of the transmission of yellow-stripe by insects.
3. Citrus insects survey and control of scales by sprays.

Division of Plant Pathology and Botany.

1. Yellow-stripe investigations.
2. The *Rhizoctonias* of Porto Rico.
3. Citrus and pineapple rots.

III. *Incidental Services.*

As stated in the "Annual Report of the Insular Experiment Station for 1918–19," for convenience, there are grouped under this heading those activities, incident to the agricultural practice of the year, whereby the farmer's seasonal problems are recorded and, as far as practicable, immediate consideration given.

IV. *Accessory Services.*

Division of Agronomy.
1. Plant introductions and collections.
Division of Chemistry.
1. Fertilizer register.
Division of Plant Pathology and Botany.
1. An herbarium.
Division of Entomology.
1. An insect collection.

Below and in the same order will be found a brief *resumé* of what has been accomplished under each group.

SERVICES IN COMPLIANCE WITH SPECIAL LAWS.

FERTILIZER ANALYSIS AND INSPECTION.

The number of registrations entered, samples received for analysis, determinations made and deficiencies encountered during 1918–19 and 1919–20 have been as follows:

	Registrations	Samples	Determinations	Deficiencies
1918–19:				
Total	164	152	367	50 [1]
Average per month	13.66	12.66	30.58	4.16
1919–20:				
Total	843	233	487	30
Average per month	70.25	19.41	40.75	2.5

The number of samples received in 1918–19 and 1919–20 were collected through three different channels, as specified below:

	1918–19	1919–20
Division of Chemistry	80	69
Subinspectors of Agriculture	24	103
Private parties	48	61
Total	152	233

[1] The deficiencies were only 28 if the Law of 1905 defining the term "deficient" is taken as a standard. According to the law of 1919 there would have been 50 deficiencies in 1918–19.

From the sale of fertilizer stamps, $7,299.63 were deposited in the Treasury of Porto Rico during the past year (1919–20).

The improvement evident in the service has been principally due to the legislative measures enacted and referred to in the annual report of this Station for 1918–19, *i. e.*, the creation of a special position of chemist for fertilizers and the levying of a stamp tax of one cent per one hundred pounds or fraction thereof upon all fertilizers, fertilizer materials, or amendments sold on the Island, the proceeds of which have accrued into a fund that will be available for the necessary supplies and equipment of the laboratory. The enforcement of the law and execution of the inspection has been greatly facilitated by the division of the responsibilities thereof between the inspection service of the Department and this Insular Experiment Station. By the present arrangement the duties of registration, inspection and sampling fall upon the former and those of analysis and report upon the latter. A Technical Board for fertilizers—consisting of the Chief Chemist of this Station as chairman and the two district inspectors of the Bureau of Agriculture and the fertilizer chemist as the three other members—was, furthermore, created by the Commissioner of Agriculture. This Board has during the year considered all questions that have arisen or have been submitted to it in connection with the service and has made recommendations to the Commissioner of Agriculture for its further improvement.

A further step in the separation of fiscal from research services should be taken by limiting the duties of the Board so that it may act only in an advisory capacity in those questions submitted to its consideration and by authorizing and directing the fertilizer chemist to handle all the routine fertilizer business himself under direct orders and supervision from the San Juan office as is done in the case of the plant inspection and quarantine service. The object of this change is to release the Chief Chemist of this Station from the administrative responsibilities of this service, which have in reality fallen upon his shoulders as chairman of the Board in such degree as to make it nearly impossible for him to devote any time profitably for the work for which his division was intended.

Reports of the analyses performed and other convenient data have appeared monthly in the *Revista de Agricultura de Puerto Rico.* A full report will appear annually in the shape of a Bulletin of

this Station. Bulletin No. 21, "Abonos,"[1] contains the 1918–19 report.

PLANT INSPECTION AND QUARANTINE.

The plan referred to in the annual report of this Station for 1918–19, and by which the authority and responsibilities of the service would rest with the Chief of the Bureau of Agriculture, was carried out during 1919–20. The Insular Experiment Station has acted only in an advisory capacity on all those questions submitted to it for its consideration, through the action of those members of its staff who are also members of the Technical Board created by the Commissioner of Agriculture, September 6, 1919. This Board is composed of the Director of the Station as chairman and four other members: the expert in cane diseases, the pathologist, the entomologist and the head quarantine inspector.

The routine of inspection is carried out by the quarantine inspector and his clerical auxiliary in San Juan and three other inspectors: one at Mayagüez, one at Ponce, and one at Ensenada—the only authorized ports of entry for plants and plant products in Porto Rico. The inspector at Ensenada has been acting only during the cane season.

The questions submitted to the Board during 1919–20 and its resolutions and recommendations will be fully discussed in the annual report of the plant inspection and quarantine service, which will appear as a bulletin of this Station. Bulletin 23 contains the 1918–19 report.

Reports of the inspection and data and observations allied therewith have appeared monthly in the *Revista de Agricultura de Puerto Rico*.

SUGAR-CANE SEED DISTRIBUTION.

As customary, two distributions were made during 1919–20, one in the fall and one in the spring. The total tonnage distributed was 120.88 tons and the numbers of solicitors, residing in 28 towns of the Island only 6 of which were not railroad stations, was 101. This is low as compared with the previous year; but a good number of the fields planted for distribution could not be cut for seed due to profuse flowering and ripening of the cane by reason of the unusual

[1] Fertilizers.

drouth and the unexpected delay in the cutting brought about by the cutter's strike.

The distribution of the seed and the inspection of the plantings made with it were organized in accordance with the plan reported upon in 1918–19, field records having been taken by Mr. F. S. Earle during his numerous trips over the Island; by Mr. F. Joglar in August, 1918; by Mr. Luis A. Izquierdo in August, 1918; by Mr. P. González, Horticulturist, in August, 1918, and by Mr. Pedro Richardson, Plant Breeder, in June 29, 1920.

The results obtained from the above inspections were very disappointing. They showed that, in the first place, the seed cane arrived in very poor condition for planting due to seemingly uncontrollable delays in shipment, transit and planting, as well as to rough handling. In the second place, in the greater number of cases the planters did not take any special care of the varieties to be tried out: records would not be taken; replants in the experimental plots would be made with different varieties; and even other commercial plantings would be replanted promiscuously with the varieties received from the Station for trial. There were many exceptions, of course; but what the petitioners in general want is *seed cane, seed cane of any kind* in order to square out their fields, especially for the fall (gran cultura) plantings when seed is not available unless a harvest field is sacrificed. If this situation is contrasted with the cost of production, selection and preparation of seed to the Station—probably higher than anywhere else—the excessive cost of transportation by cart, motor trucks, or rail, and the limited funds available for the institution's farming expenses, the wastefulness of the practice and the need of a modification of the law in force is strikingly apparent.

The distribution of seed cane should be limited to small amounts of those varieties commendable for propagation by the grower and subsequent large-scale trial in his locality by the grower also. This should naturally leave this institution at liberty to send any desirable amount of cane to any locality of the Island for its own experiments with varieties, fertilizers, etc.

INVESTIGATIONAL SERVICES.

DIVISION OF CHEMISTRY.

1. *Chemical Changes Undergone by the Grapefruit in the Process of Maturation.*—Work on this project has been finally completed

The data in hand are being systematized for final report in the next few months.

2. *An Investigation of Possible Chemical Changes in Yellow-Striped Cane.*—Mr. F. S. Earle having been commissioned by the Federal Government in the summer of 1918 to come to Porto Rico to investigate the Yellow-stripe disease of sugar-cane and establish full cooperation with both the Insular and Federal Experiment Stations on the Island, a program of work was outlined which consisted of thirteen distinct projects. Project No. 11 called for a comparative chemical study of healthy and diseased canes. It was accordingly included in our regular program and given preeminence over all other investigational projects on account of the importance of the problem.

Three topics were chosen for investigation:

1. The effect of the disease on the chlorophyll itself, as distinguished from the chloroplasts.

2. The effect of the disease on the sugar-content of the cane.

3. The effect of the disease on the enzymes (oxidases) of the cane juice.

A study of the first topic was suggested by the report of Wilbrink and Ledeboer of Java describing various color changes of cane leaves and stems in certain varieties under the influence of the disease. A thorough revision of the second topic was very desirable divergent opinions being entertained by the sugar interests of the Island on such an important question. The third topic was undertaken in the hope that it would indirectly throw some light on the nature of the disease and establish its relations with other mosaic diseases.

The amount of team work done by the various divisions of the Insular Experiment Station in the study of Yellow-stripe during 1919–20, and of which cooperative work the chemical work under review forms part, may be appreciated by reference to *The Journal of the Department of Agriculture of Porto Rico*, Vol. III, No. 4, October 1919. "Yellow Stripe Disease Investigations" (Progress Report).

Preliminary results with two of these investigations warrant the belief that the disappearance of the pigment in Yellow Stripe is not due primarily to the decomposition of the chlorophyll as such, and to the definite conclusion that Yellow Stripe does not materially

affect the sugar content of the juice of diseased canes, except in an indirect way, when the canes become cracked as a result of the drying up of the stalks. The tendency of the yellow striped canes to an increase in their acid content is, however, noted; although this increase does not seem serious enough to cause inversion except in very acute stages of the disease and after the stalks have become cracked as a result of being badly cankered.

Comparative measures of the oxidizing activity of healthy and diseased canes were undertaken by the Director and the Chief Chemist. Lack of diseased cane at the Station and failure of shipments sent in from other places paralyzed the work temporarily, it is hoped.

3. *A Study of the Chemical Composition of the Filter-Press Cake, the Changes Wrought in it by Fermentation, and of Those Materials That Might be Mixed with it to Advantage with a view to its Full Utilization as a Fertilizer.*—The cake residues from the filter presses in sugar factories are used as a soil dressing in Porto Rico, generally after they have been allowed to ferment for a long time in large piles exposed to the weather. Field trials with such exposed residues had been already reported from the Station, when in the hands of the Sugar Producers' Association, as early as 1911 and 1912. It was thought desirable to complement the results then obtained. Analyses of exposed and unexposed cakes principally from Vannina Central and secondarily from the other centrals, have been carried on during the year, and the literature on the subject has been consulted as a preliminary step to the development of the investigation.

4. *Analyses of Cane Seedlings and Other Varieties.*—The Division of Agronomy has been carrying on for years the study of a great number of seedling canes and other varieties. In connection with the chemical selection of those canes the Division of Chemistry has been called upon to render assistance in this respect, 395 samples having been analyzed during the year.

5. *Cooperative Soil Analyses.*—In cooperation with the Division of Agronomy in its investigation on fertilizers for pineapples and sugar-cane, the Division of Chemistry has analyzed 18 samples of soils from the pineapple plots, and 57 samples from the plots of the sugar-cane fertilizer experiments.

DIVISION OF AGRONOMY.

1. *Sugar Cane Varieties.*—No seedlings have been produced since 1918, as the number was so large by that time that it was felt

that all resources of the division should be directed to testing thoroughly those already on hand. Investigations were made upon the etiology of the *"matizado"* and the so-called "gum" and "root" diseases, the relative behavior of the different varieties, the yields of these varieties under different conditions of soil and locality, content of sugar and purity of juice. This year the tests of seedlings produced by this Station during former years brought to light several that appear to be very promising. Three hundred and ninety-five chemical analyses have been made, including the duplicate analyses where the same variety was analyzed several months in succession. In this way the juice of 302 different varieties has been analyzed, including 63 of the seedlings of 1916, 30 of the 1917 seedlings and 114 of the 1918 seedlings.

The publication of cane varieties announced in last year's official report appeared as "Sugar Cane Varieties in Porto Rico," Vol. III, No. 2 of *The Journal of the Department of Agriculture of Porto Rico,* and that on cultivation as Circular No. 17. The acceptance of this circular may be judged from the fact that the edition is at present exhausted.

The results of work on varietal resistance of sugar-cane to yellow-stripe have been given out for publication as Bulletin 19.

2. *Experiences with Banana Varieties and Their Culture.*—For two years data have been gathered on the matter by the Division of Agronomy. A report is being prepared on the result of this two-years work.

3. *Experiments with Fertilizers for Pineapples.*—The report announced as forthcoming in the 1918–19 official report appeared in the 1919—January number of *The Journal of the Department of Agriculture of Porto Rico,* Vol. III, No. 1. The experiment was to be repeated with the ratoon crop, but due to the impossibility of getting the dry blood necessary for some of the plots, data on 1919–20 crop will have no value for comparison with the data obtained in 1918–19.

4. *Improvement of Rice.*—The importance of this cereal in the regimen of the people of Porto Rico is enough to justify the amount of attention this crop is receiving from both the Federal and the Insular Experiment Stations. The latter Station has been mainly interested in the hill-land types of rice grown by the Porto Rican small farmer mainly for his own consumption. The services of Dr. E. E. Barker from Cornell University were secured for this work

among others. Through his efforts rice field conditions in Porto Rico have been ascertained and a collection made of the varieties and races as they now exist in the Island. These were planted at the Station during late October and early November to the number of 574 short head-rows and in small plots. In spite of the whole plantation having been badly affected with a blight disease (*Piricularia oryzæ*), some seeds of nearly all samples were saved. The test is to be repeated during the summer of 1920.

5. *Improvement of Corn.*—The generally low production and bad quality of the corn grown in the Island made it imperative that attention be devoted to the study of ways and means to increase the former and improve the latter. Dr. E. E. Barker has also taken charge of this work. Fields have been timely visited, selections made of individually excellent plants, and many other samples of seed secured from other sources, both native varieties and exotic. These will be planted this summer.

6. *Tobacco Improvement.*—Owing to the mixture of types and varieties of tobacco in the commercial fields of the Island there is great possibility of improving the crop in uniformity and quality as well as in yield and resistance to disease.

Tobacco improvement has been started by making selections of superior plants in the tobacco fields and sowing their seeds. Samples have also been received from various sources in Porto Rico, Cuba and the United States Department of Agriculture. These varieties are to be given comparative trial at the Station and selections made from them. Cooperative work on tobacco is being done with Mr. D. A. Allard of the United States Office of Tobacco Investigations.

DIVISION OF ENTOMOLOGY.

The major part of the work of the division has been concentrated during the year upon the investigation of the possibility of the transmission of Yellow Stripe by insects.

1. *Insect Transmission of Sugar-Cane Mottling Disease.*—One hundred and eighty-three experiments were performed and reported in the year 1918–19, all but ten of which had been with so-called sucking insects, the other ten being made with chewing insects. Of this number, two plants only had shown successful inoculation with the mottling disease, apparently as result of the insect attacks.

During the fiscal year 1919 to 1920 a total of 310 additional ex-

periments were made in attempt to transmit the disease by other means. All of the 44 tests using other means than insects to transmit the disease gave negative results.

Of the 266 experiments made only 9 were with chewing insects, all of which gave negative results.

Of the 257 experiments made with sucking insects, however, 9 have to date given positive inoculation with the cane mosaic. From these figures it is seen that only 3½ per cent of the tests made with sucking insects were successful, which leaves a considerable margin of doubt in favor of the theory that these insects are the sole carriers of the disease in view of their comparative scarcity in many cane fields where the disease has been spreading rapidly.

It is very significant that of all the control plants only one became inoculated with the mottling disease, and that after it had stood for over two months in the open field near to a plant that had been experimentally diseased, from which it had undoubtedly contracted the causative organism by some means.

Fuller report of this work has been given out to the press in *The Journal of the Department of Agriculture of Porto Rico,* Vol. III, No. 4.

It was thought desirable to accompany the report in the *Journal* with "A Bibliography of Insect-Born Diseases of Plants" and a "List of Insect and Mite Pests of Sugar Cane." These will be found in pages 112 and 135.

2. *White-Grub Investigations.*—The study of the species of white grubs of Porto Rico was already in project in 1913. These studies lasted until 1917, when the final report on the *Melolonthids* was published in *The Journal of the Department of Agriculture of Porto Rico,* Vol. I, No. 3. There remained unpublished the final report on the *Dynastini.* It was the submission of this work that was included in the program of this Station for the year 1919–20. It is due from the Chief of the Division of Entomology. Arrangements have been made for its submittal before September 11, 1920.

3. *Citrus Insects Survey and Control of Scales by Means of Sprays.*—Some information on this work was advanced in the official report from this office for the year 1918–19. Final report was contemplated for April, 1920. However, due to the urgency of the entomological work on yellow stripe, at the Chief Entomologist's request a "List of Insect and Mite Pests of Sugar Cane" was published, conjointly with other reports on the disease, in lieu of the report due on citrus insects.

DIVISION OF PLANT PATHOLOGY AND BOTANY.

1. *Study of the Rhizoctonias of Porto Rico.*—Investigations of a variety of plants exhibiting symptoms of decay, and especially those which showed root trouble resulted in the accumulation of a large number of *Rhizoctonia* strains which were isolated in pure culture. This fungus form is present in the soils of Porto Rico and is causing a large amount of loss to a number of economic plants. This throws a new light on root disease here. The work on this subject is entirely new and it has, in the course of study resolved itself along two distinct lines, *i. e.*, a study of the different forms of the fungus as other soil-inhabiting fungi. These distinct types of the fungus and their specific relation to a number of certain crop diseases, and the relation of several forms of this fungus to root-disease in particular. The last-named disease was found to be in a great measure due to the attacks of one or more forms of *Rhizoctonia* as well as other soil-inhabiting fungi. These distinct types of the fungus *Rhizoctonia* were studied and determined, especially their relation to diseases of plants. A report on this subject will be published in the future.

2. *Yellow-Stripe Disease of Sugar-Cane.*—One of the most important problems and one which took up a large part of the time in research was the yellow-stripe disease of cane. As a result of experimental work and field observation, the nature of this infectious disease is now more clearly understood. There is now no doubt that it is an infectious disease caused by an undetermined organism. The results of the experiments on this problem have appeared in *The Journal of the Department of Agriculture of Porto Rico*, Vol. III, No. 4. The main points brought out were, first, that the disease is infectious, and secondly, that the infectious substance destroys the internal cells of the cane stalk and leaves. The presence of a plasmodium-like substance in groups of cells in the interior of the diseased cane stalks was demonstrated. This constitutes a new diagnostic feature of the disease and adds a great deal to the understanding of the nature of the disease itself. From observations made in the field it is clear that the disease can be held in check by eradication and seed selection.

3. *Root Disease of Sugar-Cane.*—Root disease of sugar-cane was studied. In the course of study of the effect of soil fungi on cane growth, a new organism, described as *Plasmodiophora vascularum*,

was discovered inhabiting the vascular bundles of stunted cane. A survey of the Island was made to determine the distribution of this organism, which is apparently an important factor in cane production. This organism was found at Mayagüez, San Germán district, Cayey, Río Piedras, Bayamón and Loíza in fields where the stand of cane was decidedly poor. The discovery of this organism is a new addition to our knowledge of cane diseases. Further study was made on the effect of root fungi and their relation to cane growth. This was submitted for publication in our *Journal* for January, Vol. IV, No. 1, "Root Disease Investigations."

4. *Citrus and Pineapple Rots.*—A study of this problem was continued. It was found from field observations and from a study of the methods of handling and shipping of the fruit that a large proportion of the decay is due to delay in shipment. If the fruit could reach the market within two weeks from the time they were picked the amount of decay would be minimized. The most prevalent decay of oranges and grapefruit here is that known as *Diplodia* stem-end rot, while in pineapple it is mainly a blossom-end decay. This latter is purely a mature fruit decay; that is, the decay commences in the aereal chambers of the outer part of the mature fruit, and is mostly caused by a *Fusarium.* Careful handling is recommended to avoid bruising.

INCIDENTAL SERVICES.

A wide range of topics has come under the attention of the Station during the past year in relation with these services, such as notes on the crops of the year; analyses of soils, juices, insecticides, fungicides and feedstuffs; results of the campaign for eradication of Yellow Stripe of sugar cane; principal insect pests and diseases of the year; the important parasites and diseases of live stock; eradication of the cattle tick; and the importation of pure-bred swine and goats available to the public for service without charge.

SUGAR-CANE.

The number of acres planted to cane in Porto Rico probably exceed at present the 240,000 figure. During 1919–20 the total production, as reported by the Sugar Producers' Association, was 485,887 tons, valued at over $108,000,000, based on an average price of $11.25[1] per hundredweight, or $225 per ton of sugar for 1920

[1] The average price paid the Insular Experiment Station for its cane during 1919–20 was $14.16 per hundredweight.

shipments. Inasmuch as there is some cane planted in the interior of the Island which is utilized in the making of syrup, the total value of the Porto Rican sugar-cane crop for 1919–20, exclusive of the value of the molasses, goes above that figure. Molasses exports to the United States in 1919–20 were valued at $1,141,390.

Since 1914, which marked the low level in the past twenty years, the price of sugar has gradually advanced until last year it sold for about four times what the 1914 crop brought, as the following figures will show:

	Exports (Short tons)	Total value	Average price per ton
1914	320,633	$20,240,335	$63.12
1915	294,475	27,278,754	92.64
1916	424,955	45,809,445	107.79
1917	488,943	54,015,903	110.47
1918	336,788	41,362,299	122.81
1919	351,910	48,132,419	136.77
1920	419,388	98,923,710	235.88

In this unusual prosperity both the centrals and the *colonos* have shared. As explained in the Station report for 1918–19 the more common basis for payment by the centrals for the cane delivered by the *colonos* has been a certain per cent, in tons of sugar, of the tonnage delivered at the scales. This per cent ranges from about 5.5 to about 8 [1] according to the district of the Island where the centrals are located—a factor which determines the degree of competition for cane to which it may be subjected by other centrals; the arrangements made for transportation and delivery; the general quality of the cane; and the personality and relative means of the parties entering into the deal. Centrals Fajardo, Vannina and Mercedita (Ponce) have been making settlements with their *colonos* on the basis of the sugar content of the canes delivered at the mill. A certain allowance per ton is made in many cases to compensate for transportation over varying distances.

Both methods of payment have given occasion to differences between the factories and the planters, the most important of which from the point of view of this Station being the matter of cane varieties and the sugar losses due to the practice of burning poor cane fields before cutting and through delays in shipment and grinding.

[1] Average from all data on hand, 6.88 per cent.

Three varieties have been singled out and objected to by one factory or another in making out their yearly contracts with the planters. The Demerara 625, the Yellow Caledonia and the Cavangerie. These varieties will produce a good tonnage where other varieties would fail. In those districts where each is popular one can frequently detect the plantings made with them from their decidedly better growth. With respect to the Demerara 625 it seems to be generally accepted that it is not a desirable variety to plant on account of its decidedly low purity and sugar content. In a trial extending for three years at this Station the following results were obtained with it: tonnage: plant, 56.27; first ratoon, 44.46; second ratoon, 28.52; Brix, 14.96;[1] Sucrose, 10.65;[2] Purity, 71.1. The Cavangerie had a slightly better average under the same conditions: tonnage, 53.53; first ratoon, 44.0; second ratoon, 23.00; Brix, 16.77:[1] Sucrose, 12.45;[2] purity, 75.3. Recent observations, however, have suggested that more than one cane goes under the name Cavangerie, which would thus explain the fact that some of the analysis under apparently the same conditions run low while others run high. The segregation of these red canes into the original varieties is of importance, since the Cavangerie cane is without any doubt the most resistant cane to adverse soil, climatic and cultural conditions which exists in Porto Rico to-day. Opinions differ widely as to the real value of the Yellow Caledonia as a sugar producer. Records taken at the Station[1] simultaneously with those of the two previous canes show a tonnage of 29.35 in the first ratoon;[2] 17.45 in the second ratoon; Brix, 17.22; Sucrose, 14.85; purity, 85.9. This was not an especially bad showing. At the request of various sugar interests desirous of coming to an understanding as to the real value of this cane to the central and to the *colono*, a number of isolated analyses of the Yellow Caledonia variety of cane were made. The work broadened gradually into systematic fortnightly analyses throughout the season of different plots set aside by the Station for the purpose. The data thus accumulated in the last two years, enriched further by data on the subject that will be obtained from various large-scale tests performed in several factories of the Island, should set the cane definitely at its worth.

The sugar losses through burning and delays in shipment have been had in consideration by the Station in response to the many communications received from parties interested in a fair settlement

[1] See Insular Experiment Station Circular No. 8 (1917).
[2] Average of the plant and first ratoon crops.

of their differences. Some data on the subject had already been gathered by the Federal Experiment Station at Mayagüez as early as 1910. Combined with those obtained at the Station under other conditions, it is hoped they will serve in the future as a basis for judgment.

Some of the contracts between the factory managements and the *colonos* having stipulations of per cent of sucrose, density or purity below which the cane might be refused grinding by the central, the Station has acted in many cases with their mutual consent in the nature of an impartial and reliable umpire for the supply of data and the verification of analyses necessary for agreement.

Besides the employers (factories and *colonos*) the employees the laborers have also had their share in the larger profits of the sugar industry In the 1918–19 report of the Commissioner of Agriculture and Labor to the Governor of Porto Rico the economic condition of the farm laborers of the sugar industry was truly characterized as follows: [1]

"Laborers in this industry, except those in municipalities in the western and interior parts of the Island, receive an average wage of $1 during the harvest, and 65 cents before and after the harvest. The highest wages, and a bonus besides, are paid in the eastern section. In these districts the average wage before and after the harvest was 90 cents. During the harvest the average average was $1 with many hundreds of workers who earned $1.50 per day."

"In the west and the greater part of the southwest although during the harvest men earning $1.50 and $1.25 per day may be found, still the proportion of those who earn $1 and even 75 cents is quite great. After the harvest the average is as a rule 75 cents per day."

Stimulated by the good prices in sight for sugar, at the critical time for the harvest, the farm laborers began to strike at various localities of the Island until late in January the walk-out had become pretty general. Wages of $2.50 an eight-hour day for men and $1.25 for boys harvesting the cane; $2 for men and $1 for boys cultivating cane, and $2.75–$3 for ditchers approximately represented their demands for a raise.[2]

Contracts based on those demands with some modifications were entered into by several employers. Others resisted the advance and paid lower wages. In general, it may be said that wages were for

[1] Report of the Commissioner of Agriculture and Labor. *In* Report of the Governor of Porto Rico to the Secretary of War (1919), page 705.

[2] This is equivalent to a demand of an average raise to about $2.50 per day for men and about $1 for boys.

the cutting season raised nearly 50 per cent and fell after the season to possibly 20 per cent to 30 per cent higher than at the same time last year.

The bulk of this increase in the labor cost of production has naturally fallen on the grower of the cane. Every one of his acres will bear it as long as sugar prices are in the teens. When they go down nearer to normal he will have to reduce his labor bill by making use of cheaper methods of planting and cultivation or the below-fifteen-ton acre of cane will have to go as a commercial proposition.

From data at hand kindly furnished this Office by several large centrals, it appears that at present the average cost to them per acre of plant cane approximates the following figures:

Preparation of the land	$20 to $25
Banks, holing, furrowing, planting and replanting	20 to 30
Weeding and cultivation	46 to 50
Ditching	10 to 12
Fertilizers and fertilizing	25 to 40
Cutting, filling and hauling (average of 20 tons per *cuerda*)	35 to 40
Overhead expenses, $2 per ton	40 to 50
Total cost per acre	$208 to $247

An acre of ratoons would then cost about $227.50–$47.50 (average cost of land preparation, banking, holing and planting) or $180.

Inasmuch as the return of prices to a normal level will sooner or later have to be faced by Porto Rican producers, there are only two ways of defense open to the cultivators of the poorer lands, *i. e.*, a reduction of the expenses necessary to make the crop, or an increase of production. The former might be brought about by a reduction in wages, but it looks as if such a change would be the least feasible. and at any rate the least desirable in sight. Considering that the implantation of more modern systems of culture could very well bring about not only the desired reduction in cost of production but a higher tonnage as well. this Station published Circular No. 17, "Recomendaciones Sobre el Cultivo de la Caña en Puerto Rico." Therein the problem is stated and the solution discussed at length. Two other publications specifically intended as an additional aid in this connection have been Circular 19, "La Preparación de Abonos Mezclados por el Agricultor," by F. A. López Domínguez, and Circular 23, "Variedades de Caña," by F. S. Earle.

[1] Irrigation expenses are excluded. They range from $10 to $50 per acre.

Aside from the studies conducted on the disease, yellow-stripe was the object of an eradication campaign in an effort to avert its further spread and aminorate its ill effects as a factor in the diminution[1] of yields. The eradication method of combatting it in the cane fields as advocated in Circular 14 (1918–19) of the Insular Experiment station has proved more successful than the most sanguine nature could hope for. Under the direction of this Station and ably seconded by the inspectors and subinspectors of the Department of Agriculture the method was tried and adopted by many important managements. The extent to which the eradication method has been tried and the success with which it has met may be appreciated by examining the evidence given in our Bulletin 22, "Eradication as a Means of Control in Sugar Cane Mosaic or Yellow Stripe." A further contribution towards checking the disease was made by the Federal Department of Agriculture by the importation from Argentine into Porto Rico of a large quantity of Uba (Kavengire) cane, immune to the disease. This was planted in this Station's farm and will be distributed when ready to cut.

Among the other diseases and animal pests which have exacted their usual toll from the Island's sugar-cane wealth, the following have been the subject of complaints during the year:

Diseases: root-disease and gumming.[2]

Animal Pests: the white-grubs (*Phyllophaga*), the weevil root-borer (*Diaprepes spengleri* L.), the moth stalk-borer (*Diatræa saccharalis*), the mole-cricket (*Scapteriscus vicinus*), the weevil stalk-borer (*Metamasius hemipterus*), the mealy-bug (*Pseudococcus sacchari*), crabs and rats.

Unexpected developments in connection with root disease of sugar-cane were reported during the year in *The Journal of the Department of Agriculture of Porto Rico*, Vol. IV, No. 1, "Sugar-Cane Root Investigations," by F. S. Earle and J. Matz. A popular circular on the matter will be published early during 1920–21. Circular 20, "La Gomosis de la Caña" warns the public against the presence of this disease, not heretofore known to exist in Porto Rico, and contains recommendations for its control.

[1] For a discusson of Yellow Stripe as a factor in the reduction of yields, see *The Journal of the Department of Agriculture of Porto Rico*, Vol. III, No. 4, "The Mottling Disease of Sugar Cane and the Sugar Production of Porto Rico," by C. A. Figueroa.

[2] Gumming has been only recently discovered in isolated localities of three agronomical districts of the Island.

COFFEE.

The number of acres planted to coffee in Porto Rico is given in the Treasurer's official report to the Governor of Porto Rico for the year 1919 as 158,913. Coffee exports to foreign countries rose last year (1919–20) to 31,868,177 pounds—an increase of four million pounds over the preceding year—at a total value of $8,769,047. Exports to the United States in the same year were valued at $264,981. The average value per pound was estimated at 27.6 cents as compared with 21.7 cents the year before. Considering that 197,031 acres of coffee were reported in existence in Porto Rico in 1899 and that in 1915 exports reached 51,125,620 pounds, it is apparent that there have been forces at work which have contributed to the decline of the coffee industry of the Island.

These forces are well known: disturbed market relations following the political change after the war with Spain in 1898; disastrous set back to plantations by the San Ciriaco cyclone with consequent lack of credit and firmer enthronization of the so-called system of "advances" (a feudal system of production); actual low production; and lack of facilities for cheaper transportation. The fact that coffee wealth, both land and product, is in Porto Rico more evenly distributed than any other agricultural wealth and that coffee groves are about the only protection left in the way of a forest mantle against the denudement of the highlands and the constant flooding of the lowlands below by and after the torrential rains common in the coffee districts, makes of the problems confronting the coffee industry of Porto Rico a subject for thought and effort, not only by the growers themselves but by every citizen of Porto Rico. The factors that make it economically possible that coffee groves be felled for fuel should be looked into and removed for the sake of the whole country.

The belief was expressed in INSULAR EXPERIMENT STATION ANNUAL REPORT FOR 1918 TO 1919 that in proportion as the question of markets and credits was straightened out in the same proportion would the growers be disposed to attend to their agronomical problems as pointed out by the scientific workers who have given their thought to them. It was also explained in the above-mentioned report that this Station had not as yet had an opportunity to attempt serious work with the agronomical problems of coffee. In prepara-

tion for such work, however, an eye has been kept on the industry, many members of the Station staff having during the year visited frequently the coffee regions, and their notes and the notes sent in by the subinspectors filed for future use.

It appears from such notes and observations that the average production per acre still ranges from 3 to 4 *quintales*, thus agreeing well with averages previously [1] estimated. This would put the total actual production at about 60,000,000 pounds, the same as it was estimated in calculations made for the year 1899.[2] Although bat guano, coffee pulp and stable manure, where available, are in many individual cases used to fertilize the crop, the use of artificial manures is not practiced generally. Among the important injurious coffee or coffee-shade pests reported during the year may be counted an ant (*Myrmelachista ambigua ramulorum*), a leaf miner (*Leucoptera coffeella*), a moth borer (*Psychonotua*), a white grub (*Phyllophaga*), a beetle *stem-borer* (*Apate francisca*), a white ant (*Eutermes*), the coffee-shade (*guaba*) shot-hole borer (*Xyleborus*) and a weevil (*Lachnopus*). The diseases reported as prominent during the year have been: A root disease (*Rossellinia*), a leaf-blight (*Pellicularia koleroga*), a leaf-spot (*Stilbella flavida*), and a fruit-spot (*Cercospora coffeicola*).

An increase in average production per acre without proportionately increasing the cost of production would make it easier for the coffee growers to tide over periods of market depression, a result which seems entirely feasible considering the opportunities for improvement offered by the coffee plantations to-day.

In an effort to popularize the existing knowledge in regard to some of the most troublesome coffee pests, one circular has been prepared for publication early in 1920–21; "La Enfermedad de la Raíz en el Cafeto." Others will follow in succession.

TOBACCO.

The 1919 crop has been estimated at about 25,000,000 pounds taken from about 22,912 acres. Following the high prices at which this crop was sold (35 to 42 cents per pound) a large acreage was

[1] A Report on the Agricultural Resources and Capabilities of Porto Rico. House of Representatives Document No. 171, 56th Congress, 2nd session, by S. A. Knapp.

[2] The Condition of the Coffee Industry in Porto Rico. Circular No. 2, Porto Rico Federal Experiment Station, by J. W. Van Leenhoff.

planted for the succeeding season. The 1920 crop, however, although still variously estimated at from 40 to 50 million pounds, did not come up to expectations neither in quantity nor in quality. These facts, coupled with the return to the market of the Porto Rican American Tobacco Company, caused a sudden rush of buyers, sales having been made at prices ranging from 55 to 70 cents per pound. Porto Rican tobacco has been lately growing in favor with manufacturers to such a degree that the belief has been expressed that the demand for it would run the crop manyfold over the actual production, total exports for 1919–20 having already risen to the following figures: 227,027,000 cigars, valued at $11,613,997; 9,517,000 cigarettes, valued at $83,618; 17,095,715 pounds leaf tobacco, at $12,573,221 and 3,411,150 pounds of scrap tobacco to the value of $843,167.

In 1900 [1] the production was estimated at 4 to 6 hundredweights per acre. From data at hand the yield per acre at present would appear to approach the 7–8 hundredweight figure. No two factors would probably help more in improving the yield and the quality of the product than more attention to the selection of seed, and judicious fertilizing. The former is as a rule supplied the grower. The fertilizing practice varies from the use of none to 8, and in exceptional cases 10 and 16, hundredweights per acre.

As in previous years the mole-cricket (*Scapteriscus vicinus*), the flea-beetles (*Epitrix*, three species, and *Systena basalis*), a slug (*Veronicella* sp.), the horn-worm (*Phlegothontius sexta*), the tobacco leaf-folder (*Pachyzancla perusalis*), a weevil (*Diaprepes spengleri* ?) and grasshoppers have been reported as doing damage to the crop. The use of insecticides not being practiced as generally as it is desired and, the knowledge of the properties and value of those offered for sale in the local markets not being well understood, Bulletin No. 20, "Insecticidas y Fungicidas," was put through the press and distributed.

Among the diseases reported are the mosaic disease, damping off, leaf spots and a foot-rot, probably the one known in the Coamo district under the name of *capote*. Preliminary examinations of the latter condition by Mr. Matz of the Division of Pathology, resulted in the establishment of *Phytophthora terrestria* as the causative organism.

[1] S. A. Knapp. Loc Cit.

CITRUS FRUITS.

In the 1919 official report,[1] the total number of acres planted to "oranges" (citrus fruits) is given as 6,122. This estimated acreage leaves out of consideration the oranges growing wild in the coffee districts. The exports of citrus fruits for 1920 have been as follows: grapefruit, 419,629 boxes at a value of $1,332,742; and 336,300 boxes of oranges, worth $882,346. The number of boxes of wild and cultivated (an insignificant proportion) oranges shipped annually forms a considerable proportion of the total fruit exported from the Island, those exported from Mayagüez, Ponce and Aguadilla during the fiscal year 1919–20 having mounted to 236,166[2] boxes.

Better shipping facilities, a reduction of losses due to fruit rot in transit and the utilization or disposal of low-grade fruit have been the main problems confronted by the growers during the year. In connection with the latter point it may be of interest to note that 10,379 gallons of grapefruit juice, valued at $78,504, were exported to the United States during 1919–20.

The data obtained by the Station on the matter of fruit decay are being arranged for publication. A circular on "Citrus Culture in Porto Rico" was prepared by Mr. F. S. Earle during the year and will be sent to the press early after July 1, 1920.

A grower's observations on the effect of potash fertilizers on the grapefruit have been aided by potash determinations in a number of samples—including fruit and limbs.

Complaints last year relative to insect pests and diseases of citrus groves have included: the orange leaf-weevil (*Diaprepes spengleri*), scale-insects, a red spider, scab, gummosis, mal-di-goma and die-back.

As will be seen by reference to our investigational projects of work, page 17, this Station was giving special attention during the past year to the study of citrus insects and their control.

PINEAPPLES.

In the official annual report for 1919 the number of acres devoted to pineapples in Porto Rico is given as 2,879. Exports for 1920 amounted to 140,906 crates, valued at $479,461, which would indicate

[1] Report of the Governor of Porto Rico to the Secretary of War (1919).
[2] United States Customs Service Records.

an average price of about $3.40 per crate. The reports at hand for the past year put the average yield per acre at from 200 to 300 crates.

As usual, the crop has been practically free from any diseases or serious insect pests, mealy bugs, red spider, ants and white grubs being sometimes observed.

As in the case of the orange and grapefruit, the principal drawback to the pineapple industry has been the lack of shipping facilities and the loss of fruit through decay in transit. The latter point has been covered together with the study of citrus-fruit rot mentioned above under "Citrus Fruits." The results obtained will appear together early in 1920–21.

COCOANUTS.

According to official figures for 1919 [1] there were 9,152 acres of land in cocoanuts in Porto Rico at the time. During 1919–20, 16,845,000 [2] nuts worth $1,129,752,[2] were exported to the United States from the Island. Nuts to the value of $12,660 [2] were exported to foreign countries. This would place the average price at over $67 per thousand nuts of all sizes. Estimates of production per acre differ widely, probably due to the unequal productivity of the different groves and of individual trees. Data obtained from a grove in the Loíza district puts the yield of 25 acres at 40,000 nuts a year, or 1,600 nuts per acre—which seems low. Apparently from an equally reliable source the production of 75 acres in the Humacao district was placed last year by their owner at 226,165 nuts, or over 3,000 nuts per acre—which may seem a little too high. If the Food Commission's [1] average of 66 nuts per palm and about 56 per cent average of palms in production in Porto Rico are taken as the basis of calculations, and granting 50 trees to the acre, the average production per acre would be about 1,800 nuts.

The greater part of the Porto Rican cocoanut business has consisted in the exportation of the husked nut, although a little copra is made from the cracked nuts. Exports of copra to the United States during 1919–20 amounted to 83,859 [2] pounds, valued at $6,822.[1] This copra is of a very inferior quality. An attempt made

[1] Report of the Governor of Porto Rico to the Secretary of War.

[2] United States Customs Service records.

[1] Primer Informe Anual de la Comisión de Alimentos al Gobernador de Puerto Rico. mayo, 1917 a junio 30, 1918, pág. 109.

about 20 years ago to extract the oil from the cocoanut on a commercial scale failed, and has not—to our knowledge—been duplicated again. Three attempts at building up a fiber and fiber products business have been made recently by enterprising concerns. None of the plants, erected at considerable expense, are now functioning.

The importance to the Island of Porto Rico of a new industry, based on the products of the cocoanut, cannot be overestimated. Realization of this fact and the demand of private interests for data on the cocoanut and its cultivation prompted this Station last year (1919–20) to prepare a circular on the subject and to look more closely into the industry. This circular will be published during 1920–21. In regard to the products of the fiber industry, we have been informed by the pioneer in the industry, Mr. Francisco Busó of Humacao, Porto Rico, that the trouble with the machines is that they tear up too large a percentage of the total fiber in the husk, in such a way that only from 18 to 20 per cent is obtainable as a long fiber. This, coupled to the high cost of baling and transportation, made the business possible only during periods of high prices.

Quotations for long fiber rose during the war as high as $100 a ton; then declined as low as $50 a ton. In 1919–20 205,786 pounds of fiber were exported to the United States at a value of $13,769. This would place the average export price at over $72 per ton.

The cocoanut groves of Porto Rico are singularly free from serious diseases or pests. During the year a *Diplodia* rot has been under the observation of the Division of Plant Pathology. Damage by the rhinoceros beetle (*Strategus quadrifoveatus*), a shot-hole borer (*Xyleborus* sp.) and certain scales has been recorded from several districts of the Island.

COTTON.

Sea Island cotton is grown in Porto Rico, almost exclusively in the northwestern part.

There are no official figures on the acreage planted to cotton in Porto Rico. As the result of a survey of the cotton district made in April, 1920, by order of the Commissioner of Agriculture, acreage figures were incidentally obtained. They totalled about 3,000. A reduction must have taken place, since Gandía & Stubbe in 1907 in their commercial pamphlet on cotton[1] culture placed the acreage

[1] Instrucciones para la Siembra y el Cultivo del Algodón "Sea Island" (1902).

at about 8,000 acres. Exports for 1920 were officially reported to have been 349,008 pounds, worth $193,260. This would mean an average price of about 55 cents per pound. Reports in hand seem to show that growers in the Island get $15 a hundredweight for their seed cotton at the farm. Taking it that seed cotton contains 30 per cent lint, the value actually paid the grower for the lint was 43 cents a pound (the value of the seed taken to be about 3 cents a pound 1919 United States average). Production is reported to vary from 3 to 8 hundredweights of seed cotton per acre.

Data furnished by the subinspector of the Aguadilla district place at 5 hundredweights the average production of seed-cotton per acre. This is not so bad as might be expected, considering that no fertilizers at all are used, in accordance with the records of the same subinspector.

Recent and very careful surveys, made by the Insular and Federal Departments of Agriculture have shown that neither the boll-weevil nor the pink boll[2] worm have been found to exist on the Island. The corn-boll-worm does some damage, due to the fact that control measures are either unknown or not put into practice. Recently the leaf-blister mite has been reported present. Die-back rust and mildew seem to be the diseases most commonly met with. It has been found during the year by the Division of Pathology[3] that mildew, which is causing little concern in other countries, is in Porto Rico a serious if not the most serious cotton disease so far. The causative agent of this disease, *Ramularia areola* Atk., thrives with greater vigor here than it does in other less humid climates.

SISAL.[1]

There are at present about 575 acres planted to sisal in Porto Rico. Some of this is about ready to be harvested and made into fiber. The outcome of this first crop will have great effect on the future of this planting, for which there is unutilized land available in Porto Rico.

These plantings are due to the propaganda efforts of the Federal Experiment Station at Mayagüez and of the Insular Legislature

[2] See Plant Quarantine and Report of the Entomologist.

[3] Notes by Mr. B. López, Assistant Pathologist.

[1] Due to the kindness of Mr. A. Lluberas of Yauco, Porto Rico, owner of 500 of the acres planted to sisal in Porto Rico, has it been possible to insert the data given below in connection with the status of sisal on the Island.

which in 1905 appropriated $10,000 for the encouragement of the agricultural development of the Island. The money was placed at the disposal of Mr. D. W. May of the Federal Experiment Station, 75 acres having been planted in unutilized government land on the south coast. Recently the Department of Agriculture ceded Mr. May $1,000 additional to take care of those 75 acres, for some time neglected for lack of funds.

This Station obtained and planted some seed from the Federal Experiment Station for future distribution of suckers among those interested in giving the crop a trial.

The difficulties experienced by Mr. Lluberas in the growing of sisal have been of a two-fold nature. In the first place, he has found that the plants do not attain a proper development, the leaves staying short, due in his opinion to the effect of the yearly droughts intensely felt in the highlands where the sisal is planted. In the second place, the impossibility of profitably paying to workers in the sisal plantation the same high wages paid in the sugar-cane fields and the natural dislike of the laborer to work in the thickets and among briers when they can always find more pleasant work in the cane lowlands. He does not intend to extend his plantings this year.

BAY.

The largest plantings of bay are to be found in the south and southeastern parts of the Island in the vicinity of Patillas and Guayama. There are some plantings in Cabo Rojo also.

The essence is distilled from the leaves in nearby stills and practically all sold to the few individuals who trade in bay rum on the Isand.

MINOR CROPS.

In 1900, when Dr. S. A. Knap reported to Congress on the agricultural resources of Porto Rico, under the heading "Minor Crops" he included corn, rice, beans, sweet potatoes, bananas, peanuts, citrus fruits, pineapples, cocoanuts and vegetables. The subsequent development of the citrus, pineapple and cocoanut industries have placed them among the important export classes. The remaining ones, although minor in the sense of the export business, are nevertheless vital to the economy of the people of Porto Rico. Never before had there presented itself an opportunity to realize the degree to which

these minor crops were vital to the Island as during the World-War and following period of transition. The situation is very well depicted in an article which appeared in the *Porto Rico Progress* for June 18, 1920. The article follows in its entirety:

"LOCAL PRODUCE HIGH.

"Never in the history of Porto Rico have its vegetable products been so extortionately high as they are at the present time. Sweet potatoes, a food so generally used all over the Island, are selling at six cents a pound, when they were never known to sell for more than three cents. Plantains, which are prepared in so many ways and help in a large measure to make a variety in the menu, are now selling for eight and ten cents apiece when they sold not long ago for from two to five cents. Tomatoes, not very good ones, are twenty-five cents a pound, and a small head of lettuce that never cost over four cents is now sold for twelve cents.

"All other foodstuffs are equally as high, but the fact that these native products have taken such a leap is difficult to realize, and presents a problem difficult to solve. There are innumerable families who depend upon these native products for their daily sustenance, and the scarcity and resultant outrageous price of them means semi-starvation for hundreds of people. Even the middle classes cannot buy what is necessary to make a healthy menu, at the price the commonest vegetables are selling for to-day, and the working classes who have depended so largely upon codfish and sweet potatoes for their mid-day meal are simply unable to buy sufficient of these for their families because of the present price asked for them.

"Quoting from a recent article in *El Mundo*, the writer says: 'Measures should be taken to regulate the prices of foodstuffs in comparison with the wages earned by the middle and laboring classes. Our thinking people should make it their business to look into this matter. Our legislators should find the remedy and enforce it without vacilation, as the peace and welfare of the Island depends upon the laws they make. In Cuba and in other countries the legislators have passed bills obliging the agricultural people to set apart a portion of their lands to the cultivation of minor products. If such a step as this were taken in Porto Rico the production of vegetables and other foodstuffs would increase greatly, and the present harassing situation would promptly be relieved, in a radical way.

" 'During the months that the sugar-cane crop is maturing, beans, corn, chick peas, kidney beans, etc., could be planted and fine crops could be raised. Take the tobacco planters—What use do they put their lands to from May to November? None whatever, yet during those months sweet potatoes, onions and potatoes could be planted, and everyone would be benefitted by the crops harvested from them.

" 'Porto Rico can produce all that its inhabitants need for their sustenance. In Isabela, Quebradillas and Camuy onions superior to those which are imported, are raised. The finest kind of chick pea (*garbanzo*) is raised in Aibonito, Lares, Jayuya and other districts.

" 'The question of higher wages would be settled with the lowering of prices, and especially the lowering of those articles of food most essential to family life. The workingman asks for more wages because everything costs him

four or five times more to-day than it did before the war. This should be brought to the attention of the agricultural men of the Island. It is necessary to make the land produce as much as it can produce for the maintenance of the inhabitants of the country. This would be an act of real patriotism and would contribute in a very large and forceful way to the solution of this important problem which is confronting us. They should not wait for a law to be passed which will oblige them to do this when if they look the question squarely in the face they can readily see how they can help to avoid the strikes which are breaking out continually and upsetting the country from day to day, and can help to bring about an equitable state of affairs for the well-being of their own countrymen.

" 'The big planters of the Island and the *centrales* should be the first to start this food-production campaign. When prices are such that the laborer can buy enough to eat for himself and his family there will be no more strikes, and there will be harmony and a fraternal spirit between the laborer and the patron, between the establisher of the industry and those who developed it by the labor of their hands and the sweat of their brow.' "

The question of production, being the most important, is naturally the one emphasized in the above article. What can be done in this direction is illustrated by the fact that through the activities of the Food Commission the 102,575 [1] acres planted to minor crops in 1916–17 increased to 334,725 acres in 1918.[1] The market records of this Department show that there is another very important phase of the problem—that of distribution. Lack of facilities for marketing alone could make it possible for the same product to vary over 100 per cent in different localities of the Island, as will be seen by the following data selected at random from the market reports at hand:

[1] Report of the Governor of Porto Rico (1918), page 47.

Products.

Locality	Corn		Bananas		Plantains		Rice		White beans		Red beans		Sweet potatoes		Yams		Peas		Yautias	
	R	W	R	W	R	W	R	W	R	W	R	W	R	W	R	W	R	W	R	W
Aguadilla	$0.06	$5.00	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Barranquitas	.06	5.00	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Cidra	.06	5.00	.....	.....	.....	$2.50	.....	.....	.....	.....	.....	.....	$0.04	$3.00	.....	.....	.....	.....	.....	.....
Comerío	.06	5.00	.....	$0.80	.....	.....	.....	.....	.....	.....	$0.18	$17.00	.03	2.00	.....	.....	.....	.....	$0.04	$3.00
Jayuya	.08	5.00	.....	.80	.....	.....	.....	.....	.....	.....	.....	.....	.03	2.00	.....	.....	.....	.....	.....	.....
Lares	.06	5.00	.....	.80	.....	2.50	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Santa Isabel	.06	5.00	.....	.....	.....	2.50	.....	.....	.....	.....	.....	.....	.04	3.00	$0.04	$3.00	.....	.....	.....	.....
Moca	.06	5.00	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Yabucoa	.06	5.00	.....	.....	.....	.....	$0.09	$8.00	.....	.....	.....	.....	.....	.....	.....	.....	$0.09	$8.00	.....	.....
Isabela	.13	11.50	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.03	2.00	.....	.....	.....	.....	.....	.....
Fajardo	.12	11.00	.....	.....	.....	.....	.....	.....	$0.10	$8.00	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Juana Díaz	.....	.....	.....	.....	.....	.....	.....	.....	.10	8.00	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Toa Alta	.....	.....	.....	.....	.....	.....	.....	.....	.12	8.00	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Arroyo	.....	.....	.....	.....	.....	.....	.....	.....	.11	8.00	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Mayagüez	.....	.....	.....	.....	.....	.....	.09	8.00	.11	9.00	.....	.....	.....	.....	.....	.....	.09	8.00	.....	.....
Rincón	.....	.....	.....	.....	.....	.....	.....	.....	.11	9.00	.11	9.50	.03	2.00	.....	.....	.....	.....	.....	.....
Río Piedras	.....	.....	$0.02	1.25	.....	.....	.18	12.00	.18	16.00	.16	16.00	.....	.....	.....	.....	.18	12.00	.....	.....
Vega Alta	.....	.....	.....	.....	.....	2.50	.....	.....	.18	16.00	.....	.....	.04	3.00	.....	.....	.....	.....	.04	3.00
San Juan	.....	.....	.02	.....	$0.07	5.50	.....	.....	.12	10.00	.....	.....	.07	4.00	.08	.....	.....	.....	.06-8	6-8
Patillas	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.10	8.00	.....	.....	.....	.....	.....	.....	.....	.....
Utuado	.....	.....	.....	.80	.....	2.50	.....	.....	.....	.....	.....	.....	.03	2.00	.....	.....	.08	7.00	.....	.....
Coamo	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.04	3.00	.....	.....	.....	.....
Adjuntas	.....	.....	.....	.80	.....	2.50	.....	.....	.....	.....	.....	.....	.....	.....	.04	3.00	.....	.....	.....	.....
Maunabo	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.03	2.00	.....	.....	.....	.....	.....	.....
Barros	.....	.....	.....	.80	.....	2.50	.....	.....	.....	.....	.....	.....	.03	2.00	.....	.....	.....	.....	.03	2.50
Aguada	.....	.....	.....	.....	.....	2.50	.....	.....	.....	.....	.....	.....	.04	3.00	.....	.....	.....	.....	.....	.....
Añasco	.....	.....	.....	.80	.....	.....	.09	8.00	.....	.....	.....	.....	.04	3.00	.....	.....	.09	8.00	.....	.....
Naguabo	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.04	3.00	.....	.....	.....	.....	.....	.....
Vega Baja	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.04	3.00	.....	.....	.....	.....	.....	.....
Villalba	.....	.....	.....	.....	.....	2.50	.....	.....	.....	.....	.....	.....	.04	3.00	.....	.....	.....	.....	.....	.....
Ciales	.....	.....	.....	.....	.....	2.50	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.04	3.00
Río Grande	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.04	3.00
Lajas	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.06-8	6-8
Guayanilla	.....	.....	.....	.....	.....	2.50	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.06-8	6-8
Salinas	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.06-8	6-8
Vieques	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.06-8	6-8
Guánica	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Quebradilla	.....	.....	.....	1.25	.....	2.50	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Peñuelas	.....	.....	.....	.....	.....	2.50	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Manatí	.....	.....	.....	.....	.....	.....	.08	7.00	.....	.....	.....	.....	.....	.....	.....	.....	.08	7.00	.....	.....
Ponce	.....	.....	.....	.....	.....	.....	.09	8.00	.....	.....	.....	.....	.....	.....	.....	.....	.09	8.00	.....	.....
Toa Baja	.....	.....	.....	.....	.....	.....	.....	.....	.18	16.00	.22	22.00	.....	.....	.....	.....	.....	.....	.....	.....
Otros pueblos	7-10¢	$6-9	.....	$6.60-1	.....	$3-4	12¢	$9-11	12-14¢	$10-13	14¢	12.00	.06	4.00	.06	4.00	.12	$9-11	.05	4.00
% máximo de variación	116⅔%	130%	0%	816%	0%	120%	44.4%	50%	80%	100%	80%	112%	133⅓%	100%	100%	33⅓%	62½%	71.4%	166⅔%	220%

R = Retail. W = Wholesale.

Some remarks with reference to the minor crops are given below under each.

Corn.—In 1897 Porto Rico was an exporter of corn and corn meal, 4,246,776 pounds of corn and 7,946 pounds of corn meal having been shipped to Cuba and 30,133 pounds of corn to Spain. To-day Porto Rico imports corn meal to a value of about $200,000 a year. The reason why more corn is not grown in Porto Rico in those lands not occupied by more valuable crops seems to be the fact that the low yield generally obtained makes it an unprofitable crop, the average production per acre according to reports at hand, being estimated at about 550 pounds. This low yield—and the estimate is probably too high—may in part be explained by the fact that no fertilizers are generally [1] used and to the lack of initiative in putting into practice measures for the control of its animal enemies, principal among which are rats, cutworms, the mole-cricket, worms, birds (*mozambique, chango, tórtolas*) and grubs. The degenerate seed generally used is also an important factor to be taken into consideration. When attention is paid to these factors, very good corn crops are the result as in certain sections of Coamo, Aibonito and Yauco. The corn acreage in Porto Rico previous to September 1, 1917, was estimated by the Food Commission [2] to reach the 37,031 figure.

Rice.—As a result of a survey of the rice industry in Porto Rico made in the fall of 1919 by order of the Commissioner of Agriculture and Labor the number of acres then devoted to it in Porto Rico was estimated at 4,386½ [3] without irrigation and 25 with irrigation, with an average production of 199 pounds for the non-irrigated to 600 pounds for irrigated ones per acre. This rice is used only for local consumption near where produced, the Island having imported in 1920, 133,449,140 pounds of rice, valued at $14,194,188. The uat lowland fields being occupied with sugar-cane, a more certain and at present more valuable crop, this rice is grown in the mountains without flooding, since there falls as a rule enough rain for the crop. The types planted are all mixed.

The important place of rice in the regime of the people makes any increase in its production in this country of real benefit to the masses. It has, for this reason, been a favorite subject of work for

[1] Stable manure is used in some cases.

[2] Primer Informe Anual de la Comisión de Alimentos al Gobernador de Puerto Rico, (mayo, 1917–junio, 1918), pág. 103.

[3] According to Mr. W. A. Mace, of the Porto Rico Federal Experiment Station, there were in 1919 22,000 acres of rice with a production of 5,000 tons. The Food Commission, in its first annual report, placed this figure for 1917 at 12,075 acres.

the experimental stations. The Insular Station has been for the past year working mainly with the upland types.[1]

Birds (*chango, mozambique, tórtola*) and the mole crickets are common causes of serious damage to rice. Cases of disease have been very rare, the most important being the appearance of rice blast (*Piricularia*) in plantings of various types made at this Station for comparison.

Bananas.—The bulk of our banana crop comes from the coffee districts where the plant is used as a temporary shade for the new plantings. In its many varieties and multiple uses it contributes one of the principal foods of the laboring classes, the Food Commission having placed the number of plants in Porto Rico up to June, 1918, at 49,132,203. Any mishap to the crop is keenly felt by the great mass of the people. This has befallen the banana in the form of the banana wilt. It has gradually spread until a very common and susceptible variety, the *chamaluco,* has in many cases become rare in the local markets. Circular 25—"*El Mal del Guineo,*" of this Station was published last year as a contribution to the control of the disease. There are other pests of the banana but they are negligible by the side of the former.

Aside from some stable manure in cases where available, no fertilizers are used with the crop. Systems of culture are also in their infancy, for which reason this Station is giving the matter its attention.

Onions.—A good deal of attention has been paid recently to the growing of onions in Porto Rico. Bermuda onion seed brought mainly from the Canary Islands is generally used, the planting of other varieties being risky to say the least. In spite of the fact that onions have during the harvest rotted in the ground, presumably for lack of a market, the value of onion importations from the United States reached $173,742 and $54,346 from other countries.

In 1918[2] the onion plantings in Porto Rico were estimated to reach a total figure of 566 acres. Las year's reports would seem to treble this figure and estimate the yield per acre at from 2,000 to 5,000 pounds. A yield of 12,000 pounds has been reported from Guayama, although it appears rather unusual. Aside from the use of some stable manure, where available, no fertilizers are generally

[1] See report of the Agronomist, pages 71 and 72.

[2] Primer Informe Anual de la Comisión de Alimentos al Gobernador de Puerto Rico (mayo, 1917, a junio, 1918).

used on the crop. Some insect and cryptogamic parasites of the crop have been reported. The losses which they cause do not compare, however, with those sustained by the imperfect methods of curing, grading, storing and marketing the product.

Beans and Peas.—With rice they constitute an article in the daily diet of the Porto Rican table. During 1919–20 beans were imported to the value of $1,589,303. The number of acres planted to bean and peas in Porto Rico previous to September 15, 1917, has been estimated at over 40,000 acres.[1] Reports of yield per acre range from 200 to 600 pounds. This would give an average of about 4 hundredweights per acre. Aside from the use of stable manure, when available, no fertilizer is used. A moth, a slug and a pod-borer have been reported as doing damage to beans, cowpeas, and pigeon peas. An injurious disease of beans has been under attention by the Division of Pathology.

Sweet Potatoes.—The sweet potato plantings in Porto Rico previous to September 15, 1917, have been estimated at 28,746 acres. The only estimate of average yield reported for the past year puts it at from 1,500 to 2,500 pounds per acre. Serious damage is being wrought on the sweet potato plantings all over the Island by the two weevils *Cylas formicarius* (*el piche*) and *Cryptorhincus batatæ*. They have been under observation by the Division of Entomology, the printing of a circular on the matter having been under contemplation.

Cassava (*Yuca*).—This is a favorite food crop with the peasants, who seem to distinguish very well the sweet from the poisonous varieties. Cases of poisoning are however, not rare. Plantings of *yuca* previous to September 15, 1917, were estimated by the Food Commission [1] to amount to 5,731 acres. The only average estimate of yield per acre for the past year puts it at about 2,000 pounds. A stem-borer was reported doing damage to the crop. It has been under observation since.

Yams.—Plantings of yams are seen in small patches sparsely distributed throughout the Island. A total of only 3,425 acres have been estimated by the Food Commission [1] to exist previous to September 15, 1917. The only estimate of average yield reported for the past year puts it at from 2,500 to 5,000 pounds per acre.

[1] Primer Informe Anual de la Comisión de Alimentos al Gobernador de Puerto Rico, mayo, 1917, a junio 30, 1918.

Yautías.—The Food Commission [1] estimated a total of 9,997 acres of *yautías* planted in Porto Rico previous to September 15, 1917. The average yield reported for the past year puts it at from 2,500 to 3,000 pounds per acre. Mr. I. Torres, then Subinspector of the Department for the district of Bayamón, reported a yield of 7,000 pounds during the last harvest. A very disease of the *yautía* (*el mal*) is commonly found in the plantings. A circular on it will be published during 1920–21.

Sesame (*Ajonjolí*).—It is grown in Porto Rico on a small scale and the seed utilized for candy making and refreshments. The largest plantings are made in the Aguadilla district. Subinspector Mayoral of that district estimates their extension at 150 acres in all. The estimates of yield per acre range from 2½ to 6 hundredweights valued at from 10 to 20 cents a pound. Samples of sesame attacked by a scale were received from Arecibo during the year.

Peanuts.—Small plantings of peanuts are to be found scattered over the Island. The Spanish peanut is the variety generally grown. No further data are at present available. During the year samples of peanut foliage damaged leaf spots (*Cercospora* and *Uromees*) have been received at this Station for examination.

Ginger.—Exports of ginger root were an important part of Porto Rico's export business in years past No data are available in regard to the crop on the Island except that during 1919–20 there were exported to the United States 57,706 pounds of ginger root valued at $3,666. Information has been advanced this Station to the effect that relatively larger quantities could probably be placed in the United States market for confectionery purposes.

Annato (*Achiote*).—The trees grow wild in the coffee districts. There was exported to the United States during 1919–20 annato seed to the amount of 316,094 pounds, valued at $16,808. This would place the average value somewhat over about $0.053 per pound. The fact that much green seed has been exported from Porto Rico has done injury to the business, since only perfectly ripe seed will give a maximum yield of dyeing material. A short article on the annato trade in Porto Rico written by Mr. J. H. Ramírez, Assistant Chemist of the Station, appeared in Vol. IV, No. 2, of *La Revista de Agricultura de Puerto Rico* for February, 1920.

[1] Primer Informe Anual de la Comisión de Alimentos al Gobernador de Puerto Rico, mayo, 1917, a junio 30, 1918.

Other Vegetables.—The poor quality of those available has been no less a source of discomfort to the housewife than their actual scarcity during the past years. Numerous letters in the Station files show that lark of seed of good quality has been an obstacle in the way of many wishing to make plantings. The matter of seed supply deserves careful consideration. In an article which appeared in *La Revista de Agricultura de Puerto Rico,* Vol. IV. No. 4, the Horticulturist of this Station, Mr. P. González Ríos, embodied some of his experience in growing vegetables in Porto Rico.

Pastures.—The number of acres of land classified as pasture lands in the Treasurer's report [1] for 1919 is given as 1,014,741. Superficial observation will, however, evince the fact that a great portion of the so-called pasture lands should really be classified under the next heading, "Timber and Brush Land," with the unproductive brush lands of Porto Rico. Mr. E. Murray Bruner, Chief of the Insular Forest Service, considers [2] 500,000 acres a more adequate total for the cultivated pastures of Porto Rico.

Timber, Brush Lands.—According to the Treasurer's report for 1919 there are approximately 445,932 acres of timber and brush lands on the Island. Mr. E. Murray Bruner,[2] considers 1,100,000 acres a more adequate figure for the total of timber, brush and unproductive lands of Porto Rico. The problem which these lands present is of great magnitude, and its study and solution undoubtedly the most urgent agricultural need of the country. Mr. E. Murray Bruner, Chief of the Insular Forest Service, in two successive articles which appeared in *La Revista de Agricultura de Puerto Rico,* Vol. III, Nos.6 and 7 (1919), has ably stated the problem and presents a program of work towards its solution so far as it comes within the province of his service. Mr. F. S. Earle in two consecutive articles, also appearing in numbers 1 and 2, Vol. IV, of *La Revista de Agricultura de Puerto Rico,* touches upon this problem with many valuable suggestions.

ANIMAL INDUSTRY.

Formerly large numbers of live-stock of excellent quality were exported from the Island. The exports have gradually declined as the following table will illustrate:

[1] Report of the Treasurer. *In* Report of the Governor of Porto Rico to the Secretary of War (1919).

[2] El Problema Forestal de Puerto Rico, by E. M. Bruner, *Revista de Agricultura de Puerto Rico,* Vol. III, No. 8.

Exports of Porto Rican Live Stock.[2]

Year	Horses and mules		Cattle	
	Number	Value	Number	Value
1901	4,143	$118,694	12,829	$457,938
1902	2,406	64,930	13,357	354,065
1903	1,540	32,114	11,273	291,650
1904	4,187	101,405	13,110	316,131
1905	2,574	73,917	8,185	206,655
1906	767	22,329	7,161	150,679
1907	104	6,586	215	4,071
1908	115	17,270	11	600
1920	No exports have been officially reported this year.			

The total number of animals is in the official report of the Treasurer for 1919 given as 214,125 head grouped as follows: (1) Work cattle, 65,887; (2) other cattle, 116,072; (3) horses, mules and donkeys, 30,946; (4) other animals, 12,020. This latter figure is evidently too low. All appear, moreover, too low when compared with corresponding figures compiled by the Food Commission during the months of December, 1917, and January, 1918. These are as follows:[1] Oxen, 123,259; cows, 107,453 and calves, 95,046 (a total of 325,758 head of cattle); horses, 62,954; mules, 9,305 (a total of 72,259 horses and mules); hogs, 102,336; goats, 49,127 (a total of 151,463 hogs and goats); and 976,084 head of poultry.

However that may be, the supply of live-stock products is utterly insufficient to satisfy the demand as shown by the quantities and value of animal products imported from the United States and foreign countries during 1919–20:

Products	Quantity	Value
Pickled pork ---- pounds	7,738,768	$1,979,054
Lard ---- id.	5,384,030	1,603,132
Lard compounds and substitutes ---- id.	5,984,148	1,547,918
Butter (United States) ---- id.	855,529	366,005
Butter (foreign) ---- id.	----	108,885
Cheese (United States) ----	1,832,643	614,951
Cheese (foreign) ----	----	62,646
Milk ----	4,104,734	643,047
They aggregated a total value of ----	----	$6,925,638

[1] Primer Informe Anual de la Comisión de Alimentos al Gobernador de Puerto Rico (mayo, 1917 a junio 30, 1918), Table V, p. 110.

The Food Commission made during its short existence efforts to relieve this untenable situation. Thanks to their efforts and those of the War Department and of Hon. Félix Córdova Dávila, Porto Rico's Resident Commissioner in Washington, authorization was obtained for the importation, and importations actually made, of cattle from the Virgin Islands for purposes of slaughter. That Commission also advocated and worked in the direction of the importation of improved breeds of poultry, swine, goats and dairy cattle for sale to the farmers at reasonable prices or at cost. Special attention was also given to the eradication of the cattle tick.

Simultaneously with the Food Commission, but independently, efforts in the same direction were being made by the present director and by Dr. J. Bagué, now Veterinarian of the Station, then at the College of Agriculture at Mayagüez. As a result animal-industry work was initiated at the Insular Experiment Station, importations of specimens of the Tamworth, Berkshire and Duroc Jersey breeds of swine and the Toggenburg breed of goats having been successfully carried out during 1919–20. Stimulated by their scarcity, importations of good specimens of dairy cattle, hogs and poultry have been made by private parties. Fresh attempts to interest the authorities in dairy and poultry work at the Station are contemplated. Further details of the work done in this connection, inclusive of the campaign for the eradication of the cattle-tick, may be had by reference to the report of the Veterinarian, page 95.

Attention has also been given to the common diseases of livestock which, last year as well as in the previous years, have contributed their share to the animal-industry failure in Porto Rico. Among them there have been reported:

Anthrax.—This disease is enzootic in the lowlands of Porto Rico. Particularly serious losses were reported last year from Fajardo, Naguabo, Humacao, Canóvanas, Río Grande, Loíza and Río Piedras. Outbreaks in Lajas and the southern district have become rarer due to the more general use of the anthrax vaccine.

Hog-Cholera.—Outbreaks of this disease have been reported during the year from nearly every district, especially important ones having occurred in Manatí, Ciales, Barceloneta, Río Piedras and Arecibo. The seriousness of these outbreaks may be judged by the fact that in from 3 to 4 months and in only 4 wards of Manatí [1]

[1] Communication from Mr. F. Cuevas Laforet, Special Teacher of Agriculture, Manatí, Porto Rico.

122 head of young swine, valued at from $700 to $800, died from cholera. Circular 21, "El Cólera del Cerdo" (Hog Cholera), was given out to the press during the year.

Blackleg.—This disease is enzootic, like anthrax, in the lowlands of Porto Rico, although not as virulent. Only one positive case came under the knowledge of the Station last year.

"Ranilla."—This is an important though obscure disease of cattle. Known cases in Porto Rico are limited to the southern district. This is a disease to which more attention should be given on account of its frequent seriousness, estates being known where 10 cases, one after another, have occurred in two day's time.

Lymphangitis.—This is common all over the Island and known under the names "lamparones" and "mal de botones." Its infectiousness is not generally realized.

Glanders.—The number of cases have diminished recently due to the activities of the sanitation service and the increase in the use of the oil motor as a source of power. Being such a dangerous disease and communicable to man in the extreme, farmers should be better informed of its nature.

Texas Fever.—Porto Rican native cattle are practically immune to Texas fever. Cases which have come under the notice of this Station have all been with imported cattle and have all been fatal. The nature and seriousness of the disease is not realized by the average farmer with the result that costly purchases of imported cattle made by them have turned out to be a total loss when transferred to their farms soon thereafter. Circular 18, "Extirpación de la Garrapata," (Eradication of the Cattle Tick) was published during the year.

Animal Parasites.—Most of the cattle in the Island being pastured in low, wet land the prevalence of parasitic diseases is not surprising. Notable among them is the verminous bronchitis of calves and hogs, the cysticercus (locally "Pepita") and the liverfluke or "Cucaracha" (*Dystoma hepaticum*). The horn-fly (*Hæmalobia serrata*) is very annoying to cattle in Porto Rico. Two articles on this fly, written by Mr. E. G. Smyth. Entomologist of this Station, appeared during the year in Vol. III, No. V and VI of *La Revista de Agricultura de Puerto Rico.*

Bee-Keeping.—Exports of honey from Porto Rico during 1919–20

amounted to 3,559,694 pounds, valued at $445,177. Beeswax exports reached 33,401 pounds. worth $12,066.

La Revista de Agricultura de Puerto Rico.—This monthly is the official organ of the Department of Agriculture and Labor. It is published in Spanish under the immediate direction of the Sub-Commissioner of Agriculture. The Chief of the Bureau of Agriculture is the Managing Editor. The role of the Director of the Insular Experiment Station has during the year been merely that of providing articles and news relative to the work of the Insular Experiment Station. It has been already noted elsewhere that the Station publishes in it monthly a fertilizer and plant-quarantine report.

The articles appearing in the *Revista* from the pen of members of the Station staff during 1919–20—not including the fertilizer and quarantine reports—have been:

Vol. III, No. 2.
1. Cómo se Coleccionan y Conservan los Insectos, por E. G. Smyth.
2. Pudrición de la Base en las Plantas de Hortalizas, por J. Matz.

Vol. III, No. 3.
3. Preparación y Conservación de Insectos, por E. G. Smyth.
* 4. Dominio de los Insectos de los Cítricos, por E. G. Smyth.
5. Liquidación de Caña, por I. A. Colón.

Vol. III, No. 5.
6. Dominio de la Plaga de la Mosca del Ganado en Puerto Rico, por E. G. Smyth.
7. El Mal del Plátano, por P. González.
8. Cuarentena de Plantas, por M. Crespo.

Vol. III, No. 6.
9. Dominio de la Plaga de la Mosca Cornúpeta, por E. G. Smyth.
10. El Comején, por M. Crespo.
11. La Diarrea Blanca, por J. Bagué.

Vol. III, No.7.
12. Algunas Enfermedades del Follaje de las Plantas, por J. Matz.
* 13. Enfermedades del Citro (continuación) por J. A. Stevenson.

Vol. IV, No. 1.
14. Problemas Económicos de Puerto Rico, por F. S. Earle.
* 15. Enfermedades del Citro en Puerto Rico (continuación), por J. A. Stevenson.

Vol. IV, No. 2.
16. Problemas Económicos de Puerto Rico, por F. S. Earle.
17. Achiote (Annato), por J. H. Ramírez.

Vol. IV, No. 3.

18. ¿Hay Economía Doméstica en la Isla de Puerto Rico? por E. E. Barker.

*19. Enfermedades del Citro en Puerto Rico (continuación), por J. A. Stevenson.

*20. Un Insecto muy Dañino a las Palmitas de Coco, por M. Crespo.

Vol. IV, No. 4.

*21. Enfermedades del Citro en Puerto Rico (continuación), por J. A. Stevenson.

22. Legumbres, por P. González Ríos.

23. El Problema Pecuario, por J. Bagué.

Vol. IV, No. 5.

*24. Nuestro Amigo el Anolis, por E. G. Smyth.

*25. Enfermedades del Citro en Puerto Rico (continuación), por J. A. Stevenson.

Vol. IV, No. 6.

*26. Enfermedades del Citro en Puerto Rico (continuación), por J. A. Stevenson.

27. El Problema Pecuario (continuación), por J. Bagué.

28. Injerto de la Berenjena Cimarrona, por P. González Ríos.

CIRCULARS IN SPANISH.

Little of the knowledge existing and the experimental work in agriculture done in the Island has, in the past, been made available to the people of the Island in the form of popular publications in the Spanish language.

The need of a change in this procedure was imperative. Accordingly a start was made last year (1918–19) in that direction with the publication of Circulars 14 and 15 in Spanish. A step further has been taken this year (1919–20) by adopting the policy of publishing the majority of Station Circulars in Spanish only, as long as available printing funds were not sufficient for publication in both languages, Spanish and English.

Furthermore, additional funds were obtained for the publication of twenty-four extra circulars on subjects of vital importance to the Porto Rican farmer. Only four of these special-project Circulars 19, 21, 23 and 25, have been given out to the press during 1919 to 1920 due to the fact that the grant of funds was made late in the year, under date of April 30, 1920. Eight other manuscripts are being completed for the press. It is intended to complete the remaining ones early in the fiscal year 1920–21.

NOTE.—Articles marked with an asterisk (*) were not forwarded by Director for publication.

The effect of this policy is already noticeable in the increased business of the Librarian in charge of the distribution of our publications and in the use by the public-school students and teachers of such circulars as have been received from the press.

ACCESSORY SERVICES.

Division of Chemistry.—The Division of Chemistry keeps a register of all applications for the registration of fertilizers, fertilizer materials and soil amendments. With the enactment of the new law, all brands of fertilizers, fertilizer materials and soil amendments had to be renewed, on or before August 26, 1920. One hundred and sixty-two applications for registration of fertilizers, and three for registration of amendments have been received, acted upon, and filed. This number of registrations represents 75 distinct brands of fertilizers and fertilizer materials, and 3 of soil amendments.

Division of Agronomy.—A large number of botanical specimens have been collected in various localities and added to the herbarium, which now presents a fairly complete collection of the flora of this Island.

Division of Plant Pathology and Botany.—This division is in charge of the herbarium, and added, aside from those added by the Division of Agronomy, a number of specimens to the collection.

Division of Entomology.—The Division of Entomology keeps a collection of insects of economic importance in connection with the agriculture of the Island. The experimental work conducted by the division during the year has required so much of time of the personnel of the division that the collection has not received all the attention it should. However, a considerable number of specimens, especially of minute insects, such as thrips and mites, have been added. Work has also been done with cane insects and cotton insects.

PUBLICATIONS.

The publications of the Insular Experiment Station pertaining to the fiscal year 1919–20 are:

1. Annual Report of the Insular Experiment Station of the Department of Agriculture and Labor of Porto Rico (1918–19). (E.)
2. The Journal of the Department of Agriculture of Porto Rico, Vol. III, No. 3. The Mottling or Yellow Stripe Disease of Sugar Cane, by J. A. Stevenson. (E.)

3. The Journal of the Department of Agriculture of Porto Rico, Vol. III, No. 4. Yellow Stripe Disease Investigations (Progress Report), by F. S. Earle, C. A. Figueroa, E. D. Colón, F. A. López Domínguez, J. Matz and E. G. Smyth. (E.)
4. The Journal of the Department of Agriculture of Porto Rico, Vol. IV, No. 1. Sugar-Cane Root Disease Investigations, by F. S. Earle and J. Matz. (In press.) (E.)
5. The Journal of the Department of Agriculture of Porto Rico, Vol. IV, No. 2. The White-Grubs Injuring Sugar-Cane in Porto Rico, by E. G. Smyth. (In preparation.) (E.)
6. Bulletin No. 19. The Resistance of Cane Varieties to Yellow Stripe or the Mosaic Disease, by F. S. Earle.
   Boletín No. 19 (Edición española). La Resistencia de las Variedades de Caña a la Enfermedad de las Rayas Amarillas o del Mosaico.
7. Boletín No. 20. Insecticidas y Fungicidas, por I. A. Colón. (S.)
8. Boletín No. 21. Abonos, por F. A. López Domínguez y R. Vilá Mayo. (S.)
9. Bulletin No. 22. Eradication as a Means of Control in Sugar Cane Mosaic or Yellow Stripe (The Year's Experience with the Method), by F. S. Earle.
   Boletín No. 22 (Edición española). La Extirpación del Mosaico de la Caña como Medio de Represión, por F. S. Earle.
10. Bulletin No. 23. Plant Inspection and Quarantine Report (1918–19), by E. G. Smyth. (In preparation.) (E.)
11. Circular 17. Recomendaciones sobre el Cultivo de la Caña en Puerto Rico. Por F. S. Earle. (S.)
12. Circular No. 18. La Extirpación de la Garrapata; por J. Bagué. (S.)
13. Circular No. 19. La Preparación de Abonos Mezclados por el Agricultor, por F. A. López Domínguez. (S.)
14. Circular No. 20. La Gomosis de la Caña, por J. Matz. (S.)
15. Circular No. 21. El Cólera del Cerdo, por J. Bagué. (S.)
16. Circular No. 22. El Mosaico de la Caña o Matizado, por F. S. Earle. (S.)
17. Circular No. 23. Variedades de Caña, por F. S. Earle. (S.)
18. Circular No. 24. La Preparación de la Disolución Arsenical para el Exterminio de la Garrapata, por F. A. López Domínguez. (S.)
19. Circular No. 25. El Mal del Guineo, por J. Matz. (S.)

Mainly due to the lack at the Station of facilities for the translation of the English manuscripts, eight circulars intended for the press before July 1, 1920, have been held over for publication during the new fiscal year.

(E) means English edition only.
(S) means Spanish edition only.

FUTURE WORK.

A criterium is necessary in the consistent selection of suitable themes for study. The view has been taken since 1918[1] that the agricultural experiment stations are, or should be, essentially utilitarian institutions. They were created so they would be useful to agriculture. Agriculture being at the same time an art, a science and a business, it is expected of those institutions that they be familiar with the art, that they improve it and raise it to the hierarchy of a science, and finally that they look into the science deeply so that the truths thus established and duly disseminated may form the basis for the maintenance and initiation of *reasonably* certain aad profitable eterprises.

In harmony with this balanced conception of the proper function of an agricultural experiment station, it was then recognized that the least that the people of Porto Rico can demand of their experiment station is an intimate and continuous contact with the needs and agricultural practices which determine our production; the satisfaction of the former and the explanation, confirmation or correction of the latter, and the substitution for them of others more modern and convenient. These requisites would bring about, as an indispensable corollary, a degree of experimental and reseach work whose quality and intensity would be taken as an index to the spirit of the institution and of the community on whose behalf its task is being performed.

Realizing, furthermore, that the farmer whom it is intended to aid *has not,* and *cannot have,* any other gauge of success than a profitable balance at the end of the harvest, no time should be wasted in trying to *force* a crop on him. On the contrary, the attitude has been taken that the logical thing to do is—

(1) Protect and maintain already established agricultural enterprises;
(2) Foster as far as economically possible those agricultural enterprises whose little development is the cause of insufficient supply and of monetary disbursements abroad:
(3) Be on the lookout for the crops, industries or products and for the pests knowledge of which must be anticipated if the country is to avoid mishap and share in the commercial movements of the future.

Perusal of Part II of this Report, "Agricultural," will show

[1] Communication of the Director of the Insular Experiment Station to the Commissioner of Agriculture and Labor under date of June 18, 1918.

what has been done during 1919–20 to keep in contact with the agricultural needs and practices; to satisfy, explain, confirm or correct them; and the unanswered problems relative to them chosen for investigation, and investigated.

More plainly still does it show wherein agricultural development has been obstructed, wherein agricultural production has been short, and lastly wherein lies yet an opportunity for service in connection with those crops whose actual prosperity it is to everybody's interest to prolong.

OPPORTUNITIES FOR SERVICE.

The Island's agricultural life and development has been obstructed in many of its phases by

1. Lack of shipping facilities;
2. Lack of facilities for borrowing money on long terms and at reasonably low rates of interest;
3. Lack of fuel wood and material for rural constructions;
4. Lack of organizations to facilitate the marketing of agricultural products.

Agricultural production has utterly fallen short of the country's needs in the following cases:

1. The milk and milk-products supply;
2. The meat and meat-products supply;
3. The minor-fruits supply.

There are opportunities for service in connection with the following necessary efforts for—

1. Increase of yield—of all acres—but especially for retention in the business, of those in sugar-cane, coffee and tobacco which, giving now only a critical yield, would drop out altogether when confronted, as they are bound to be, with a period of normal prices;
2. Better utilization of the neglected, unproductive lands of Porto Rico;
3. Protection of the farmer, by legal restrictions and unrelenting enforcement, from possible losses through misrepresentation and fraud in connection with certain products like fertilizers, amendments, seeds, insecticides, fungicides and feedstuffs;
4. Wide and immediate dissemination among the farmers, in the form of circulars *in Spanish*, of *existing* knowledge which is necessary to him in connection with his business, and to which he is entitled;

5. Stimulation of better farm methods for increasing yield per acre; provision of a safeguard to producers and consumers; and laying the foundation for a sure index for the work of improvement to be undertaken by the governmental and other agricultural agencies, by the organization and execution of periodical statistical crop and live-stock reports.

WORK FOR 1920–21.

The problem of lack of shipping facilities, lack of facilities for loans to farmers, scarcity of fuel and cheap building materials, and lack of organization of the farmer for the marketing of his products do not come within the province of this Station. It may be said, however, that the forestry problem is being given close attention by the Forest Service of the Department; that due to the efforts of the Subcommissioner of Agriculture and other public officers and the propaganda carried on in the Island under his leadership by the inspectors and subinspectors of the Bureau of Agriculture, a modified form of the Federal Farm Loan Act is expected to be soon extended to Porto Rico; and that every effort should be made by private and governmental agencies to secure those shipping facilities which will enable the Island to develop its export business without restriction.

As a contribution to the remaining problems, which properly come under the province of this Station as at present organized, there will be given below under each the projects to be continued from 1919–20 and those new ones which are proposed for 1920–21.

No. 1—*Milk and Milk-Products Supply.*

From 1919–20.

1. Eradication of cattle tick.
2. Stimulation of goat raising through importation of better sires.

For 1920–21.

3. Botanical study of plants poisonous to cattle in Porto Rico.
4. Analysis of certain native products with a view to their utilization for the preparation of feeds for live-stock.

No. 2—*Meat and Meat-Products Supply.*

From 1919–20.

1. Stimulation of sheep raising through the sale at cost of African sheep and the maintenance of sires for service without charge to the public.

No. 2—*Meat and Meat-Products Supply*—Continued.
From 1919–20—Continued.

2. Stimulation of hog raising through the importation and sale at cost of various breeds of swine and maintenance of sires for service without charge to the public.
3. Analysis of certain native products with a view to their utilization in the feeding of hogs.

No. 3—*Minor Fruits Supply*.
From 1919–20.

1. Improvement of corn.
2. Improvement of rice.

For 1920–21.

3. Banana diseases and insects survey.

No. 4—*Increase of Yield of All Acres, and Especially of Critical Acres of Sugar-Cane, Coffee and Tobacco.*
From 1919–20.

1. Study of sugar-cane varieties.
2. Fertilizer experiments with sugar-cane.
3. Improvement of tobacco.
4. Yellow-stripe investigations. Further study of the histological features of the disease.
5. Study of the gumming of sugar-cane. Varietal resistance studies from inoculation tests.
6. Study of the filter-press cakes.
7. Investigation of the possibility of the transmission of yellow stripe by insects.
8. Study of the depreciation of cane in shipping and after having been burnt.
9. Chemical changes in yellow-striped sugar cane.
10. Chemical data on the Caledonia variety of cane.
11. Analysis of soils.
12. Eradication of yellow-stripe.
13. Distribution of new varieties of cane.
14. Coffee diseases and insects survey.

No. 5—*Better Utilization of the Neglected, Unproductive Lands of Porto Rico.*
This is a broad problem work on many of whose phases is mentioned elsewhere.

No. 6.—*Protection of the Farmer against Fraud in Connection with the Purchase of Certain Products, like Fertilizers, Amendments, Seeds, Insecticides, Fungicides and Feedstuffs.*
From 1919–20.

1. Fertilizer inspection and analysis.
2. Analysis of insecticides, fungicides and feedstuffs.

No. 7—*Dissemination of Existing Agricultural Knowledge Among Farmers.*

For 1920–21. Circulars to be published:—

Agronomy:

1. El cultivo del citro en Puerto Rico (Citrus culture in Porto Rico).
2. El mejoramiento de nuestras siembras por la selección (The improvement of our crops by selection).
3. El cultivo del cocotero en Puerto Rico (Cocoanut culture in Porto Rico).
4. Abonos para piñas (Fertilizers for pineapples).
5. La renovación del terreno por medio de siembras intermediarias de plantas leguminosas (The renovation of the soil by means of leguminous plants).

Chemistry:

1. Requisitos legales que deben llenar las frutas cítricas para su admisión al mercado de los Estados Unidos (Legal requirements for the marketing of citrus fruits in the United States).
2. Datos químicos sobre las yerbas malojillo y guinea como alimentos para el ganado (Chemical data on Para and Guinea grasses as feed for cattle).

Entomology:

1. La vaquita "piche" de la batata (The sweet potato weevil).
2. Los pulgones del tabaco (The tobacco flea beetles).
3. La mosca del ganado (The horn-fly).
4. El gusano taladrador del tallo del cafeto (The coffee beetle stem borer.
5. El tenredo del café (The coffee leaf-miner).
6. El comején (The white ant).
7. Los gusanos de la hoja del tabaco (The tobacco worms: hornworm, leaf-folder).
8. La lapa del tabaco (The slug of tobacco).

Pathology:

1. La enfermedad de la raíz en el café (Root disease of coffee).
2. Una enfermedad dañina de las habichuelas (An injurious bean disease).
3. El mal de la yautía (A disease of the "Yautía").
4. La enfermedad de la raíz de la caña (Root disease of sugar-cane).
5. El salcocho en los semilleros de tabaco (Damping off in the tobacco seed beds).

Zootechnics and veterinary medicine:

1. Antrax (Anthrax).
2. El muermo (Glanders).
3. El mejoramiento sistemático de nuestras razas de animales (The systematic improvement of our breeds of animals).

No. 7—*Dissemination of Existing Agricultural Knowledge Among Farmers*—

For 1920–21. Circulars to be published—Continued.

Zootecnics and veterinary medicine—Continued.

4. La Morriña negra (Blackley).
5. Lamparones (Lymphangities).
6. La piroplasmosis o fiebre de Tejas (Texas fever).
7. La bronquitis verminosa (verminous bronchitis).
8. La cucaracha del cerdo (Liver fluke).
9. La pepita del cerdo (Cysticercus in hogs).
10. La diarrea blanca (White diarrhœa).
11. Lombrices del cerdo (Hog-worms).

Plant Quarantine:

1. Restricciones legales al comercio de plantas en Puerto Rico (Legal restrictions to the commerce with plants in Porto Rico).
2. Dos plagas del algodón que no queremos en Puerto Rico (Two cotton pests we do not want in Porto Rico (boll-weevil and pink boll-worm).
3. Una enfermedad del cocotero que no queremos en Puerto Rico (A coconut pest [Bud-rot] we do not want in Porto Rico).

Fertiliyer Analysis and Inspection:

1. Las sustancias deletéreas en los abonos comerciales, por R. Vilá Mayo.

CLASSIFICATION OF WORK BY DIVISIONS, 1920–1921.

DIVISION OF AGRONOMY.

Investigational:

1. Study of sugar-cane varieties.
2. Fertilizer experiment with sugar-cane.
3. Improvement of tobacco.
4. Improvement of rice.
5. Improvement of corn.
6. Agricultural survey of the coffee industry.

Incidental:

1. Consultations.

Accessory:

1. Plant collection and introduction (cane variety collection).
2. Seed collection.

Publications:

1. Report on cane varieties—Journal for July, 1920. Vol. IV, No. 3.
2. Report on fertilizers for sugar-cane—Bulletin No. 29.
3. Report on banana varieties and their culture—Bulletin No. 25.

Publications—Continued.

4. Circulars in Spanish—
   (1) El cultivo del citro en Puerto Rico (Citrus culture in Porto Rico).
   (2) El mejoramiento de nuestras siembras por la selección (The improvement of our crops by selection).
   (3) El cultivo del cocotero en Puerto Rico (Cocoanut culture in Porto Rico).
   (4) Abonos para piñas (Fertilizers for pineapples).
   (5) La renovación del terreno por medio de las siembras intermediarias de plantas leguminosas (The renovation of the soil by means of leguminous plants).

DIVISION OF CHEMISTRY.

Investigational:

1. Chemical changes in yellow-striped sugar-cane.
2. Study of the filter-press cakes.
3. Analysis of native products with a view to their utilization as feeds for live-stock.

Incidental:

1. Consultations, inclusive of analyses of soils, insecticides, fungicides, feedstuffs, juices, molasses, dipping solutions, etc.

Accessory:

1. Collection of important soil-forming rocks of Porto Rico.
2. Collection of fertilizer materials, insecticides, fungicides and feedstuffs.

Publications:

1. Changes Wrought in the Grapefruit in the Process of Maturation—Journal for October 1920. Vol. IV, No. 4.
2. Chemical Data on the Caledonia Variety of Cane—Bulletin 28.
3. Depreciation of Cane Through Delays in Shipping and After Being Burnt—Bulletin No. 30.
4. Circulars in Spanish—
   (1) Requisitos Legales que Deben Llenar las Frutas Cítricas para su Admisión al Mercado de Estados Unidos (Legal Requirements for the Marketing of Citrus Fruits in the United States).
   (2) Datos Químicos sobre las Yerbas Malojillo y Guinea como Alimento para el Ganado (Chemical Data on Para and Guinea Grasses as Feeds for Cattle).

DIVISION OF PLANT PATHOLOGY AND BOTANY.

Investigational:

1. Yellow-stripe disease investigations (continued) (Further study of the histological features of the disease).
2. Gumming of sugar-cane (Varietal resistance studies from inoculation tests).

Investigational—Continued.

3. Botanical study of the plants poisonous to cattle in Porto Rico.
4. Coffee and banana diseases survey.

Incidental:

1. Consultations, inclusive of specimens sent for examination.
2. Diseases of the year.

Accessory:

1. Herbarium.

Publications:

1. Report on the Rhizoctonias of Porto Rico—Journal for January, 1920. Vol. V, No. 1.
2. Citrus and Pineapple Fruit Rots—Bulletin No. 24.
3. Circulars in Spanish—
   (1) La Enfermedad de la Raíz en el Café (Root Disease of Coffee).
   (2) Una Enfermedad Dañina de las Habichuelas (An Injurious Bean Disease).
   (3) El Mal de la Yautía (A Disease of the Yautía).
   (4) La Enfermedad de la Raíz de la Caña (Root Disease of Sugar Cane)
   (5) El Salcocho en los Semilleros de Tabaco (Damping off in the Tobacco Seed Beds).

DIVISION OF ENTOMOLOGY.

Investigational:

1. Transmission of yellow-stripe by insects.
2. Coffee and banana insects survey.

Incidental:

1. Consultations, inclusive of specimens sent for examination.
2. Insects of the year.

Accessory:

1. Insect collection.

Publications:

(1) La Vaquita "Piche" de la Batata (The Sweet Potato Weevil).
(2) Los Pulgones del Tabaco (The Tobacco Flea Beetles).
(3) La Mosca del Ganado (The Horn-Fly).
(4) El Gusano Taladrador del Tallo del Cafeto (The Coffee Beetle Stem Borer).
(5) El Tenredo del Café (The Coffee Leaf-Miner).
(6) El Comején (The White Ant).
(7) Los Gusanos de la Hoja del Tabaco (The Tobacco Worms: Horn-Worm, Leaf-Folder).
(8) La Lapa del Tabaco (The Slugs of Tobacco).

ANIMAL INDUSTRY.

Investigational:

1. Cattle disease survey.

Incidental:

1. Cattle tick eradication.
2. Services of sires of goats, swine and sheep, and sale of pure-bred animals at cost.

Accessory:

1. A collection of diseased specimens and animal parasites.

Publications:

1. Circulars in Spanish—
   (1) Antrax (Anthrax).
   (2) El Muermo (Glanders).
   (3) El Mejoramiento Sistemático de Nuestras Razas de Animales (The Systematic Improvement of our Breeds of Animals).
   (4) La Morriña Negra (Blackleg).
   (5) Lamparones (Lymphangities).
   (6) La Piroplasmosis o Fiebre de Tejas (Texas Fever).
   (7) La Bronquitis Verminosa (Verminous Bronchitis).
   (8) La Pepita del Cerdo (Cysticercus in Hogs).
   (9) La Diarrea Blanca (White Diarrhœa).
   (10) La Cucaracha del Cerdo (Liver Fluke, *Dystoma hepaticum*).
   (11) Lombrices del Cerdo (Hog-Worms).

SERVICE OF AGRICULTURAL DEFENSE.

I. FERTILIZER SERVICE, 1920–1921.

1. Inspection.
2. Analysis.

Publications:

Bulletin 26.—"Abonos" (1919–20 Report).

Circulars:

1. "Las Sustancias Deletéreas en los Abonos Comerciales."

II. PLANT INSPECTION AND QUARANTINE SERVICE.

1. Port Inspection.
2. Quarantines.

Publications:

Bulletin No. 27.—"Plant Inspection and Quarantine Report for 1919–20."

Circulars:

1. Restricciones Legales al Comercio de Plantas en Puerto Rico (Legal Restrictions to the Commerce with Plants in Porto Rico).

Publications—Continued.

Circulars—Continued.

2. Dos Plagas del Algodón que no Queremos en Puerto Rico (Two Cotton Pests we do not Want in Porto Rico (Boll-Weevil and Pink Boll-Worm).
3. Una Enfermedad del Cocotero que no Queremos en Puerto Rico (A Coconut Pest [Bud-Rot] we do not Want in Porto Rico).

ANNUAL REPORT FOR THE YEAR 1919-20.

By F. S. EARLE, Expert in Cane Diseases.

Studies in regard to sugar-cane mosaic or *Matizado* have been published in *The Journal of the Department of Agriculture*, Vol. III, No. 4, dated October, 1919, but not issued until August, 1920. A further paper on this subject was published in Spanish as Insular Station Circular No. 22. This practically brought the matter down to the end of the year and nothing can be added on that heading.

The so-called Root Disease of sugar-cane has always been considered by the writer as a far more important problem than the *matizado*. Recent studies by my colleague Mr. Matz have thrown new light on this important question. This lead to the preparation of a paper reviewing this entire subject, giving a resumé of the literature and discussing methods of treatment. Much data was also incorporated in regard to the resistance of different varieties. This paper was intended for the January issue of *The Journal of the Department of Agriculture*. The manuscript was in fact completed last January, but owing to delays in printing it has not yet appeared. The investigations to be reported on this same issue by Mr. Matz represent a distinct advance in our knowledge of this most important and obscure problem.

The finding of the Sugar Cane Gum Disease in Porto Rico during the year has been a matter of grave importance. The extent of the infection has not yet been fully determined, but it is known to occur somewhat widely in the old Otaheite cane in the central hill districts where there has been no recent importation of cane varieties. Everything indicates that the disease has been present in Porto Rico for many years but that it had previously escaped detection. This is a serious disease, capable of doing very great injury. At present the losses caused by it are only local in character. Too little is known regarding the habits of this disease to venture a prediction as to the possibilities of its suddenly becoming epidemic. It is to be hoped that its presence has been discovered in time and that studies now in progress may enable us to prevent serious future losses. Some seventy years ago this disease practically ruined the sugar industry of Brazil. Since that time it has caused serious losses in

Mauritius and in Australia. It has not before been reported from the West Indies.

The fact that different varieties of cane show marked differences in power of resistance to all three of these serious diseases has served to emphasize more strongly than ever the great importance of the variety question to the sugar-cane industry.

Much of the time of the writer during the past year has been given to the study of varieties. Cooperative plantings of large lists of varieties was attempted in different parts of the Island with the hope of learning their adaptability to different conditions. Unfavorable weather has caused the loss of some of these plantings. At Central Guánica, however, a good stand was secured in a planting of over three hundred kinds in a *matizado* resistance experiment. This it is hoped will also serve as a test for root-disease resistance.

Data of all kinds is being accumulated regarding all the varieties now found in commercial plantings in Porto Rico with the view of publishing as complete an account of them as possible both from the Agricultural and the Taxonomic view points.

ANNUAL REPORT, DIVISION OF AGRONOMY.

By E. E. Barker, Chief.

Administrative.—There have been several changes in the personnel of the Division during the year, and this has resulted inevitably in interruption of policy and plans. In August Mr. James Wale assumed the position of Chief Agronomist and left at the last of November to take another in Cuba. During the month of December the general work of the Division was directed from the Director's Office and at the beginning of the new year the Plant Breeder was promoted to the position of Chief Agronomist.

The former Agronomist and Plant Breeder, Mr. H. B. Cowgill, resigned in the early part of July, 1918, and the position of plant breeded remained vacant until Dr. E. E. Barker was appointed in July, 1919. He assumed the position while still in the States, making a tour of four weeks through Florida during the months of July and August for the purpose of inspecting horticultural and agronomical practices in that State in so far as they might have bearing on the work here. He arrived to take up work at the Station early in September.

When Dr. Barker was transferred to the position of Chief Agronomist it left nominally open the position of Plant Breeder. In this position Mr. Pedro Richardson, an agronomist, was temporarily appointed March 1st and he has continued to fill the appointment until the present time. His duties have, however, been entirely agronomical, he having charge of the field work with cane.

It would make for the extended usefulness of the Station if the postion of vegetable gardener could be created in this Division at a salary so that an expert's whole time could be secured. Trials, tests and experiments could then be carried on with a view to ascertaining the varieties best suited to this locality and climate, the best times of year for planting and growing them, methods and practices of culture and quite as important as these, the marketing problems should also be studied.

Farm work.—During the past year the Station farm has been under the supervision of the Division of Agronomy and Horticulture. The difficulty of keeping the fields in good condition, pre-

paring and planting new fields and harvesting the cane crop has been greatly increased because of the advanced cost of labor. With a sum for labor fixed in the budget by the last Legislature it has been necessary to curtail projects and oftentimes to neglect the proper care of the fields in order to have enough funds with which to finish the year. The same condition will prevail during the coming year and until the Legislature appropriates a large amount of money for our labor fund. About one-third of the area of the Station farm is in a wild condition, overgrown with brush and trees. Almost all of this land would be suitable for agricultural and experimental purposes if it were cleared and plowed. Despite the lack of ample funds for labor, quite a few acres have been cleared, partly by our own laborers and partly by other *peóns* who have cleared the land on condition that they may raise a crop thereon and retain half of the produce for their own use. With a small tractor or with horses the land could be cleared in much shorter time and more efficiently than with the slow oxen on which we now have to depend for this work.

Investigational work.—The major work of the Division has been with sugar cane, as formerly. No seedlings have been produced since 1918, as the number had become so large by that time that it was felt all resources of the Station should be directed to testing thoroughly those already on hand.

The yields of these varieties under differing conditions of soil and locality, content of sugar and purity of juice. This year the tests of seedlings produced by this Station during former years have brought to light several that appear to be very promising. Three hundred and ninety-five chemical analyses have been made, including duplicate analyses where the same variety was analyzed several months in succession. In this way the juice of 302 different varieties has been analyzed, including 63 of the seedlings of 1916, 30 of the 1917 seedlings and 114 of the 1918 seedlings.

A new field has been cleared and planted with several varieties on high clay land of the farm in order to observe the behavior of these varieties on hill lands.

The fertilizer experiment which has been running for several years has been continued.

The banana variety test and the fertilizer experiment has been continued and nearly all the plants have now come into bearing.

The pineapple-experiment plot has suffered for lack of fertilizer

which during the war could not be obtained in the same ingredients as with which it was started, and while awaiting a substitution, the plot failed to receive fertilizer at all. It also suffered from the drouth that prevailed during the spring months, so it has now been decided to discontinue this particular planting.

A start has been made to gather together a collection of varieties of mangos and avocados. Several choice varieties have been received from the Insular and Federal Departments of Agriculture, and from the nursery of the Misses Leitch at Bayamón have been secured a number of others. These have been planted about the Station grounds and farm. It is desirable that a considerable area of land should be set aside for an orchard of mangos and avocados so that varieties can be tested in an experimental way with sufficiently large numbers of individual trees to give trustworthy results. Both these species are such important food trees and are so well adapted to growing in Porto Rico that every effort should be made to introduce the best varieties obtainable into very general culture throughout the whole Island. Moreover, it has been demonstrated again and again that they will ship well under suitable conditions to New York, where a fancy market awaits them. There is promise here of a new industry and source of wealth that should be fostered by the Experiment Station; indeed, the initiative should be taken here.

About 2 acres have been planted with sisal plants secured from the Experiment Station at Mayagüez. At present this is not intended for experimental purposes, but rather to propagate for distribution.

Plant-breeding work.—Since the departure of Mr. Cowgill in 1918 no plant-breeding work has been done here and except for the cane seedlings none of his productions had been preserved. All work has had to be started anew.

The three major projects in plant-breeding authorized for this year have been the improvement of rice, corn and tobacco. At once after his arrival last fall, Dr. Barker visited many fields of upland rice and made selections from individual plants, thus securing a collection of varieties and races as they now exist in the fields of Porto Rico. Other samples were secured from various other sources. These were planted at the Station during late October and early November to the number of 574 short head-rows and 9 small plots. Unfortunately, the whole plantation became badly infested with a blight disease, *Piricularia oryzæ,* which destroyed the whole test. How-

ever, some seeds of nearly all samples had been saved, and the test is to be repeated during the summer of 1920.

Fields of corn were visited and selections there made of individually excellent plants, and also many other samples of seed were secured from other sources, both native varieties and exotic. These have been reserved to be planted during the summer of 1920.

Cotton.—Incidentally, selections of a few excellent cotton plants which were growing in the plantel of the Station have been made with a view to testing their individual merits and later, if feasible, to make cotton improvement a major project.

Inasmuch as no varieties of cane yet introduced into Porto Rico or as yet produced here are immune to *matizado* it is felt by the Plant Breeder that no further time should be let to pass without securing crosses between the immune East Indian varieties and a few of our best old kinds. It is to be hoped that a combination could be secured which would unite the disease-resistant qualities of the one with the other desirable qualities of the other. Next season we shall have materials for attempting these crosses as our field of Kavangerie will then be in flower. This variety has proven itself to be entirely resistant to *matizado* under all conditions and in all localities.

Plant introduction.—Many small trees and plants have been received from the United States Office of Foreign Seed and Plant Introduction and planted at the Station for the purpose of observing their adaptability to Porto Rican conditions and their possible value as economic or ornamental plants.

It is to be hoped that the scope of the horticultural work can be so extended as to include the introduction of new economic and ornamental plants and tests of their adaptability to Porto Rican conditions. Further, investigations should here be made in the commercial growing of various classes of nursery stock and seeds for export. Since the Federal quarantine law has closed foreign sources of these commodities to America there has arisen a scarcity of them in the States. Thus has opened a great opportunity for Porto Rico to avail herself of the demand and develop a profitable new industry. Climate, cheap labor, soil and nearness to the markets of the North all combine to render this Island a suitable place for producing all classes of this stock that in the North must be raised under glass at great expense.

Special-law services.—In accordance with legal statutes on the subject we have distributed gratis to applicants a total of 120.88 pounds of prime sugar-cane seed during the past year. A large number of applications also for seed of elephant grass have been received and filled. This plant as a forage crop has demonstrated its worth under varying conditions and as it becomes better known it is increasing in popularity.

Herbarium.—Incidentally, a large number of botanical specimens have been collected in various localities and added to the herbarium which now presents a fairly complete collection of the flora of the Island.

Station grounds project.—With the advice and approval of the Director a scheme has been adopted and initiated for developing the esthetic possibilities of the grounds about the Station. The desirability of having a comprehensive and forward-looking plan by which to grow gradually has been recognized. There has been adopted a policy of considering the botanical interest of trees and plants as well as their esthetic value, and whenever possible, materials of this nature will be used for planting, other things being equal for their value as ornamental material. Toward this end one large order of palms, flowering—and foliage trees and shrubs and bulbous plants have been secured and planted.

ANNUAL REPORT FOR THE FISCAL YEAR 1919-20.

DIVISION OF CHEMISTRY.

By F. A. López Domínguez, Chief of the Division.

This Division has been called upon to do work much varied in nature during the present year. Besides carrying out its own projects of investigation, it has been necessary for its personnel to undertake considerable work to cooperate in projects originating elsewhere. Numerous little problems have come up incidentally, which have been studied and solved, and a good volume of correspondence, chiefly in the form of consultation, has been handled by the chief of the Division. A review of the most important work performed is given below under the four headings, (1) Services in Compliance with Special Laws. (2) Investigational Work. (3) Services Incident to the Agricultural Practice of the Year and (4) Accessory Services.

I. SERVICES IN COMPLIANCE WITH SPECIAL LAWS.

Fertilizer analysis and control.—On May 27, 1919, the Insular Legislature approved a more complete and comprehensive fertilizer law to supersede the old law approved March 9, 1905. This law went into effect on August 26, 1919, and under its provisions the Commissioner of Agriculture and Labor charged the Division of Chemistry of this Station with the duty of analyzing all the brands of fertilizers offered for sale in this Island, and of reporting same analyses from time to time as deemed necessary, for general information. Furthermore, the Chief of the Division of Chemistry was made chairman of a committee containing two other members, the two inspectors of agriculture, on which devolved the duty of writing rules and regulations subject to the approval of the Commissioner for enforcing the law. The committee was also made responsible for the enforcement of the law. In compliance with this, the Fertilizer Chemist has analyzed 233 samples of fertilizers and soil amendments, with a total of 489 determinations. Of these 233 samples, 7 were of soil amendments. Of the 226 fertilizer samples, 99 were collected and sent by the subinspectors of agriculture, 69 by the Fertilizer Chemist and the Chief of the Division, mostly by the former, and 58 were sent by private parties. The samples taken by official agents, 190

in all, are designated as official samples, and these are the only ones taken in consideration for the fertilizer control. In the 190 official samples were found 19 deficiencies in nitrogen, 4 in phosphoric acid, and 7 in potash. This is a very good showing, and evidences the good effects of the new law, which has practically eliminated the fraud in the fertilizer trade in this Island. Where deficiencies have occurred the purchaser has invariably received a proper rebate from the dealers, based on the extent of the deficiency and the current market prices. Many hundreds of dollars have been thus saved to the farmer by the law. There are some minor points in which the law could be amended and made of easier and more efficient application, but these recommendations can be made separately when the proper time for action comes. The results of the analyses have been published monthly in *La Revista de Agricultura*. A bulletin, No. 21, has been written giving and explaining the law, and containing the results of all analyses performed during the year 1918 to 1919, with a discussion of the results. A bulletin giving the results of the analyses performed this year in detail, with proper comment, will be shortly prepared.

As Chairman of the Fertilizer Board, the Chief of the Division of Chemistry has called several meetings of the board, in which rules and regulations for the enforcement of the fertilizer law have been adopted, and several cases of infringement to the law considered and proper action taken.

II. INVESTIGATIONAL WORK.

The following investigational projects were under study, during the year:

1. *Grapefruit Investigations.*—The investigations on the chemical changes undergone by grapefruit during the process of maturation, and those which it suffers on subsequent storage after being picked was considered closed, and several attempts made at drawing a final report on it for publication. However, the attention of the Chief of the Division, who was in charge of the work, has been so absolutely taken up by other matters that demanded immediate action, that it has not been possible for him to do so. It might be proper to say that the fertilizer-control law is chiefly responsible for keeping the Chief of the Division of Chemistry from undertaking projects on subjects of much practical importance, thus hindering the progress of our knowledge of the agriculture of the Island. It is, therefore,

most earnestly and urgently recommended that a position be created with adequate salary for an official who must be a chemist and who will take care entirely of the enforcement of the fertilizer law, responsible to the Chief of the Bureau of Agriculture, thus giving an opportunity to the Division of Chemistry of this Station to carry out the work for which it was created.

2. *Seasonal Composition of the Yellow Caledonia variety of cane.*—This work was continued during this year in the same manner as in previous years. A number of stools in different fields of the Station were allowed to stay over after the cutting period, and fortnightly or monthly samples were taken and analyzed. Besides, data have been collected from planters and sugar factories over the Island who plant and grind this variety of cane. The data will be sorted and properly assembled to determine whether or not it is necessary to continue the work next season.

3. *Analyses of seedlings and varieties for the Division of Agronomy.*—The Division of Agronomy has undertaken the study of a number of seedling canes and foreign varieties, one of the main features to be considered being the sucrose content of each kind of cane. The Division of Chemistry has been called upon to render assistance in this respect, and consequently 395 samples of cane have been analyzed for the Division of Agronomy.

4. *Chemical variations in yellow-striped cane.*—Two different investigations were carried to a successful end with regard to this project.

One was the work of the Director, Mr. E. D. Colón, who undertook to determine what effect if any had the yellow-stripe disease of sugar-cane on the chlorophyll of the leaves, with a view to determine whether the yellow stripes noticed were due to a derangement of the chlorophyll, or to a diminution in the number of chloroplasts of the leaves. Accordingly, he made a number of spectroscopic observations which showed that the spectrum of alcoholic solutions of the chlorophyll of diseased and healthy cane did not differ at all, thus pointing to the conclusion that the nature of the pigment was not altered by the disease.

The other investigation was made partly last year, and the work continued this year. The object was to determine whether the yellow-stripe disease caused any inversion of the sucrose in the cane. The work done last year by Mr. Vilá at Central Bayaney was repeated, using a larger variety and number of samples by the Chief

of the Division this season. The results unmistakably show that yellow-stripe disease has no effect on the sucrose content of the cane. It is only when the stalk cracks as a result of the drying process induced by the disease, that inversion of the sucrose occurs as a result of the fermentation that naturally ensues whenever the inner tissues of a cane are exposed in consequence of mechanical injury. Both of these works have appeared in *The Journal of the Department of Agriculture*, Vol. III, No. 4, pages 43–46 and 47–64.

The work begun last year by the Director and the Chief of the Division in cooperation on the enzymes of sugar-cane in their relation to the yellow-stripe disease could not be continued this year on account of lack of time on the part of both these officials. Again the opportunity presents itself to plead for the diminution of the routine work of the Chief of the Division of Chemistry so that a greater amount of necessary research work can be accomplished.

5. The study begun last year about the effect of fire on the weight and the sucrose content of canes both when left standing and when piled after cutting was continued this year. One more trial is contemplated before publishing results. This work was this year in charge of the assistant chemist, Mr. Ismael Colón.

6. *Filter-press cake investigation.*—This investigation has been in charge of the assistant chemist, Mr. J. H. Ramírez. Two carloads of filter-press cake have been secured from Central Vannina. One has been placed under cover and the other has been allowed to stand out in the open, and periodical tests made of samples taken simultaneously from both piles, to determine the differences. Besides, numerous samples of cake and ashes have been secured through the deputy inspectors and by the Chief of the Division from various centrals in the Island., for the purpose of determining the average composition of these products under our conditions of manufacture. It is desired to know to what extent may the ashes be used to increase the mineral content of the press-cake. Besides the laboratory work, data on the field tests, or on observations made by those who use press-cake on their soils have been gathered. In this respect it is well to say that there is no place on the Island where more complete records have been kept on this subject than at Central Fajardo. It is hoped that a complete report may be made this year.

7. Although out of program, and therefore more properly belonging in the subdivision "Incidental Work," yet because of its nature it has been regarded as proper to report under the heading "Investigational Work" the study which is being carried out by

Mr. J. H. Ramírez, under the supervision of the Chief of the Division, on the changes suffered by the arsenical solutions for tick eradication. A number of samples of the arsenical solution have been prepared according to the standard formula, and others have been obtained from the dipping vat of this Station. These samples have been variously treated with solid and liquid excreta of cattle, as well as with some of our clay soil, for the purpose of determining the effects of these material on the arsenious arsenic concentration of these solutions. The solutions, variously treated, are analyzed every 15 days and the changes noted. This investigation was suggested by another carried out by the Chief of the Division on the method of preparation of these solutions that was being employed here, and which will be reported under the heading "Incidental Work." The investigation is to be continued, but it is hoped that it may be published within this year.

8. To cooperate with the Division of Agronomy in their investigation on fertilizers with pineapples and sugar-cane, the Division of Chemistry has analyzed 18 samples of soils from the pineapple plots, and 57 samples from the plots of the sugar-cane fertilizer experiments. This is reported as investigational, as it is work in pursuance of an investigation, although in cooperation with another division.

III. SERVICES INCIDENT TO THE AGRICULTURAL PRACTICE OF THE YEAR.

Fertilizers.—Out of the total of 233 samples of fertilizers and soil amendments analyzed, 58, as already stated, were sent by farmers for the purpose of knowing their content of nutritive ingredients.

Data were gathered on the mixing of fertilizers on the farm, and a circular, No. 19, that might serve as guide to those farmers wishing to try the experiment, was published. The services of this Division were offered to all those who might require expert advice in their attempt.

Soils.—At the request of the farmers of the Island, 22 samples of soils have been analyzed to obtain data that might help in an intelligent application of fertilizers to the farms from where they came.

Minerals.—Mineral ores to the number of 13 samples have been analyzed for the purpose of determining their economic value, or for the purpose of identification. Besides, 4 samples of a lignite sent from Lares, and 3 samples of limestone were also analyzed.

Insecticides and fungicides.—Sixty-two samples of insecticides and 2 samples of fungicides were collected and analyzed for the purpose of determining to what extent are materials of this nature sold in the local market reliable and true to the guarantee they bear. Based on the data thus obtained, Bulletin No. 20, "Insecticidas y Fungicidas," was prepared and published by Mr. I. A. Colón, formerly chemist at this Station, containing tables showing the results of the analyses.

Feedstuffs.—Twenty-one samples of feedstuffs were collected and analyzed, for the purpose of verifying their guarantees, and a bulletin, giving the results, with proper comments, was written though it has not yet been published. Besides, 9 samples of native forages and feedstuffs were also analyzed to find their value as feeding material.

Sugar-cane and cane products.—Twenty-six samples of cane and and one sample of molasses were analyzed, to determine their sugar content.

Grapefruit.—Determinations of potash in 17 samples of grapefruits and 3 samples of wood from limbs of grapefruit trees have been made to cooperate with Mr. W. C. Dreier, fruit grower, in an experiment which he is conducting to determine the effect of potash fertilizers on grapefruit. Mr. Dreier has gathered very interesting data which we hope some time to publish with his permission.

Cattle-tick eradication.—In cooperation with the Veterinary Inspector in charge of the tick-eradication campaign, considerable chemical work has been done in connection with the arsenical solutions used in the dipping vats.

Preparation of the arsenical solution.—As a result of observations made that showed that the solutions used were mostly under the required strength, even when very recently made, an investigation was conducted to determine the cause of the anomaly, and it was found that the method of preparation which had to be adopted for lack of facilities, was responsible for the deficiency. Recommendations were made to change the method, and the trouble has not been present again. A circular, No. 24, "La Preparación de la Disolución Arsenical para la Extirpación de la Garrapata," has been published.

Control of the dipping vats.—For the purpose of putting in the hands of the deputy inspectors out in the Island an equipment and a method of testing the dipping-vat solutions, simple enough to allow of a rapid arsenic determination by the tank itself and accurate enough to serve as basis for the correction of the solutions

when necessary, studies were made on the development of an analytical method that would satisfy these conditions. The method given out to their field agents by the Animal Husbandry Division of the Federal Department of Agriculture was taken as a basis, and those modifications introduced which were required by our local conditions. A circular on the subject will be published shortly.

Deterioration of arsenical solutions.—The results obtained with the previous work suggested an investigation of the deterioration of the arsenical dipping-vat solutions under our own conditions. The investigation was started, and has been already referred to under the head "Investigational Work."

While the necessary equipment for the deputy inspectors arrives from the States, the Division of Chemistry is encouraging the sending of samples from the tank under operation and analyzing all those received. Instructions are there given as to how to correct those which are deficient.

Borax in fertilizers.—The fact was known that some brands of potash fertilizers manufactured in the States under the stress of war conditions were high in their borax content, and that injury to corn and potato plantations had resulted from their careless use. As a result, 55 samples of fertilizers have been examined qualitatively for borax. Many more will be examined and quantitative determinations made in all those samples giving positive tests. An announcement on the matter was given to the press and a circular will be published giving the results obtained. It should be noticed that the new fertilizer law, which was written by Director Colón and the Chief of the Division of Chemistry, contains provisions whereby damage suffered by the presence of any obnoxious substance in a fertilizer could be made the basis of a legal claim against the dealers.

IV. ACCESSORY SERVICES.

A register has been kept of all applications for the registration of fertilizers, fertilizer materials and soil amendments. With the enactment of the new law, all brands of fertilizers, fertilizer materials and soil amendments had to be renewed on or before August 26, 1919. One hundred and sixty-one applications for registration of fertilizers, and three for the registration of amendments have been received, acted upon, and filed. This number of registrations represents 75 distinct brands of fertilizers and fertilizer materials and 3 of soil amendments.

ANNUAL REPORT, DIVISION OF ENTOMOLOGY.

E. GRAYWOOD SMYTH, Chief.

The major part of the work of the Division has been concentrated during the year upon attempts to determine the methods of transmission of several diseases of plants. The experiments that have been made have been designed to establish definitely whether or not these diseases may be transmitted by insects.

It is the belief of the Entomologist that very much can be accomplished in the way of control of certain important and serious plant diseases of the Island by the application of appropriate treatment for the control of one or another of the insect pests attacking these plants, when it shall have been proven just what species of insects are responsible for carrying the diseases. It is a well-established fact that as much, if not more, injury is done to plants and crops by insects indirectly, as result of diseases which the insects cause to spread rapidly from plant to plant, as results from the direct injuries from their attacks.

Three diseases have thus far been worked upon, all of them important to the agriculturist or horticulturist of the Island from the standpoint of the injuries which they inflict and the disastrous diminution of the corresponding crops resulting from their injuries. These are the sugar-cane mottling disease, the *citrus scab* and the *bean mosaic*.[1] In magnitude of the financial losses resulting from it, the sugar-cane mottling disease far outweighs the other two; yet the latter are by no means minor diseases, and each exacts its annual tribute from the citrus orchardist or from him who attempts to grow minor crops of the legume class.

The results of the experiments performed in the artificial transmission of these diseases by means of insects will be discused under separate headings in the paragraphs that follow.

INSECT TRANSMISSION OF CANE MOTTLING DISEASE.

In the writer's report for the fiscal year 1918–1919[2] was given some account of the experiments which had been made by him up

[1] The discussions relative to citrus scab and bean mosaic have been omitted, because only those projects included in the official program find proper place in this official report.

[2] Report of the Commissioner of Agriculture and Labor of Porto Rico (from the Report of the Governor, 1919), Bureau of Insular Affairs, War Department, Washington (p. 699).

to July 1st, 1919, in artificial transmission of the disease by means of insects. It was stated that a total of 183 experiments had been made, of which all but ten had been with so-called sucking insects. the other ten being made with chewing insects. Of this number, two plants only had shown successful inoculation with the mottling disease, apparently as result of the insect attack, one of them being from the attack of the West Indian cane-fly, *Stenocranus sacchari-vorus* Westw., the other from attack of the sugar-cane leaf scale, then determined as *Aclerda tokionis* Ckll., but later identified by Mr. Harold Morrison as *Pulvinaria iceryi* Guer.

During the fiscal year 1919–1920 a total of 310 additional experiments were made by the writer in attempts to artificially transmit the sugar-cane mottling disease. Of this number, 266 experiments were made by using insects that had previously fed upon mottled cane, while 44 experiments were made in attempt to transmit the disease by other means. Of the latter number, 27 experiments consisted of attempts to transmit the disease by crushing the juice of diseased cane into the leaf tissue of healthy cane, using very young, vigorous plants, and 17 experiments were attempts to transmit the disease by spreading quantities of finely cut-up diseased tissue, either in juicy or dry condition, over the healthy plants and over the soil immediately surrounding them. All of these 44 tests gave negative results.

Of the 266 experiments made with insects, only 9 were with chewing insects, which all gave negative results. Of the 257 tests made with sucking insects, however, 9 have, to date, given positive inoculation with the cane mosaic. Of the 9 plants, 2 became diseased following attack of the West Indian cane-fly, *Stenocranus sacchari-vorus* Westw., 1 following attack of the yellow cane aphis, *Sipha flava* Forbes, and 1 following attack of the sugar-cane mealy-bug *Pseudococcus calceolariæ* (?). Three plants became diseased in cages containing both cane-fly and yellow aphis, and 2 plants in a cage containing both cane red-spider (*Oligonychus viridis* Bauks) and the false-mottling leafhopper (undetermined). In the case of the last five inoculations it was not possible to fasten the responsibility on a single species of insect. From these figures it is seen that only 3½ per cent of the tests made with sucking insects were successful, which leaves a considerable margin of doubt in favor of the theory that these insects are the sole carriers of the disease, in view of their comparative scarcity in many cane fields where the disease has been spreading rapidly.

It should be stated that the disease-transmission experiments mentioned above were all very carefully controlled. All plants came from cuttings from a field where no mottling disease has been present for over a year, the cuttings were disinfected with bichloride of mercury solution and then germinated in moist chambers, and as soon as they were planted were at once covered with a glass lamp chimney to prevent insect attacks. Side by side with each and every test plant was grown a control plant, of same cutting and same age, which was either subjected to no artificial treatment, or to treatment quite different from that to which the test plant was subjected. And it is very significant that of all the control plants only one became inoculated with mottling disease, and that after it had stood for over two months in the open field near to a plant that had become experimentally diseased, from which it had undoubtedly contracted the causative organism by some means.

PLANT QUARANTINE WORK.

A very important service rendered to the Island by the Department of Agriculture and Labor is that of safeguarding its agricultural industries from the invasion of foreign plant pests by means of the vigorous execution of the plant-quarantine laws and regulations. These laws prohibit the importation of any living plants or plant products from a foreign land unless accompanied by certificate specifically declaring them to be free from insects and diseases, and they further require the fumigation or destruction of any imported plant materials coming in violation of the law, or found, upon examination, to be in any manner contaminated by a dangerous pest.

For five years past the plant quarantine service has been conducted as a part of the work of the Insular Eperiment Station, and the inspection of imported materials has been done almost wholly by the Entomologist and his assistants. A recent session of the Legislative Assembly, however, enacted a new law providing for a special officer, a plant quarantine inspector, to be located in the San Juan office of the Department and to have charge of all plant-quarantine work under direction of the Commissioner.

On August 20 of the past fiscal year the formal transfer was made of the quarantine work from this Division to the new office established in San Juan, and the former Assistant Entomologist was made Chief Quarantine Inspector, thus relieving the Division of Entomology of this work. However, a Technical Board of Plant

Quarantine was appointed by the Commissioner, consisting of four members in addition to the Quarantine Inspector, of which the Director of the Station was made presiding officer. As a member of the Technical Board the Entomologist has been frequently called upon to make important decisions in regard to matters involving questions of injurious insect attack, and on one occasion has been appointed by the Commissioner to take charge of a group of inspectors in the execution of an important field investigation, made shortly following the introduction of a large quantity of cotton seed from South Carolina that was found to be infested with large numbers of dead cotton boll weevils, and a very few living ones.

By some error the chief quarantine officer had not been appraised of the arrival of the shipment of cotton seed, and it had been sold to cotton growers and in large part planted before the fact was determined of its being infested with weevil and having been imported in violation of the law. An action was brought against the importer and fine levied by the Court, and in addition to this all seed not already planted, amounting to over a dozen sacks, was required to be sent to the office of the Entomologist, where it was destroyed by burying, following its examination. Very thorough field examinations were promptly made, by an adequate force of inspectors under charge of the Entomologist, on all properties on which the imported seed had been planted, and every additional precaution taken that was possible to prevent any outbreak of the weevil. As a result of these precautionary measures, planned after full consultation of the Technical Board with the Commissioner of Agriculture, it may be said that all danger of infestation of Island cotton by the dreaded boll-weevil has safely passed, and there is little to be feared now of any future outbreak of the pest. In fact, at no time have the living weevils been encountered in our cotton fields, which fact is largely due to the prompt action taken by the Commissioner.

One other matter has come before the Technical Board of Plant Quarantine during the year which demanded a decision on the part of the Entomologist. Very early in the year a representative of the Federal Horticultural Board was sent to the Island to make thorough inspections of the cotton fields and report on the pests present. He reported that neither the boll-weevil nor the pink boll-worm were present in our fields, but did find, however, that our cotton was infested to some extent by the cotton leaf-blister mite, *Eriophyes gossypii*, a pest present in several other of the West Indies but not thus far reported from the United States. As a result of this dis-

covery, announcement was sent out by the Chairman of the Federal Horticultural Board that a hearing would be held in Washington on June 29th to consider the establishment of a quarantine against importation of Porto Rican cotton or cotton seed into the States When this announcement reached the Insular Experiment Station a meeting of the Technical Board was at once called by the Director to consider the matter. Resolutions were drawn up by the board and forwarded to the office of the Commissioner, which were designed to show that the contemplated quarantine would inflict great injustice upon the cotton growers of the Island and would be in fact very unjustifiable for the following reasons: (1) Cotton lint is the only cotton product exported to the States from the Island, and it has never been satisfactorily proven that the leaf-blister mite is carried on cotton lint; (2) Cotton lint goes only to New York and is used in local New England mills, so in no event would reach southern mills or the vicinity of cotton fields; (3) All cotton lint entering New York is fumigated by the vacuum process, so the danger of introducing living mites with the lint is thus eliminated; (4) All cotton lint sent from here could be easily certified as to its destination in a northern mill, if necessary, thus eliminating any chance of its reaching cotton fields.

A draft of these resolutions was duly forwarded by the Commissioner to Washington and presented before the hearing of the Federal Horticultural Board on June 29th by Mr. J. A. Stevenson, a former pathologist of the Insular Experiment Station. According to a communication received by the Entomologist from the Chief Inspector of Ports of the Federal Horticultural Board, Mr. E. R. Sasscer, it appears that our Department has presented a satisfactory defense of the interests of the Island in relation to the proposed quarantine, and that no quarantine will be established against cotton products of the Island until it has been satisfactorily shown that fumigation with hydrocyonic acid gas, as practised at the port of New York, is incapable of killing the mites. It is proposed to make some cooperative experiments with the Federal Horticultural Board in fumigating cotton seed to determine these facts concerning the leaf-blister mite.

MANUSCRIPT WORK.

During the current year a number of articles have been written by the Entomologist bearing on questions of insect control, in addition to the annual report for the preceding year. Most of these

have appeared in Spanish in *La Revista de Agricultura de Puerto Rico,* the official organ of the Department, for circulation among the Spanish-speaking classes of the Island. One article and several important notices have been published in journals outside of the Department. A total of approximately 170 printed pages (and 9 plates) have appeared during the year as contributions from the pen of the Entomologist. A list of these articles appears at the end of the report.

The most important contribution of the year has been the article on insect transmission of the cane-mottling disease (No. 8 in the list), in which full tables and results are given of all the experiments that had been performed up to near the end of the year 1919. The article is enriched by a table in which are listed a number of other important plant diseases known to be transmitted by insects, and valuable comparisons are made of the deportment of the various diseases in such manner as to throw some light upon the problem of control of the mottling diesase. A bibliography of important writings on insect transmission of plant diseases is added. Following this article, in the same number of the *Journal,* appears an annotated bibliography of writings on Porto Rican cane insects, listing 135 articles, which is intended as a reference medium for use of anyone working on the cane insects of the Island. A third contribution in the same number of the *Journal* is a list of the cane insects of the Island, in which over 60 species are listed—more than double the number given in any previous list. Of each pest the following information is briefly given: name (common and scientific), family and order; damage; distribution; host plants; natural enemies (animal, insect, fungus and bacterial); and control methods.

Among the articles published in *La Revista,* the most important is that on control of the horn-fly pest of cattle (No. 5 in the cattle infested with the fly, all stages of the fly (enlarged), and plans and illustrations of various devices for destroying the flies. This article gives a very complete resumé of all experimental work that has been done in the United States in control of the horn-fly, and discusses in full the most successful sprays as well as the manner in which horn-flies are destroyed by birds.

A later article dealing with the lizards of Porto Rico, (No. 7 in the list) and describing the manner in which they hold in check many injurious insects of the Island, is one of general interest to the farmer.

PUBLICATIONS.

The Annual Report of the Station (1918–1919).

(1) Report of the Division of Entomology, pp. 27–31.
A brief resumé of plant inspection and quarantine, of work on the cane-mottling disease, and work on citrus insect pests.

The Journal of the Department of Agriculture of Porto Rico.

(2) Insects and Mottling Disease (Vol. III, No. 4, Oct. 1919. pp. 83–116, 8 tables).
Full discussion of experiments performed in insect transmission of the disease, and the results. Includes a bibliography of writings on insect transmission of other plant diseases.

(3) An Annotated Bibliography of Porto Rican Cane Insects (Vol. III, No. 4, pp. 117–134.)
A list of 135 titles.

(4) List of the Insect and Mite Pests of Sugar-Cane in Porto Rico (Vol. III, No. 4, pp. 135–150).
Lists 65 species, and gives damage, distribution, host plants, natural enemies and control methods for each species.

In the Journal of Economic Entomology, Concord, Mass.

(5) To Keep Out Cane Butterfly (Vol. XIII, No. 1, Feb. 1920, p. 149).
A note on the measures taken by the Insular Government to prevent cane introduction for planting from Santo Domingo.

(6) Butterfly Migrations (Vol. XIII, No. 2, Apr. 1920, pp. 259–260).

ANNUAL REPORT OF THE DEPARTMENT OF PLANT PATHOLOGY AND BOTANY, 1919–1920.

By JULIUS MATZ, Chief.

As a member of the Technical Board, created to advise and assist in the carrying into effect the plant quarantine regulations, the Chief of the Division took part in conferences held to revise and modify certain restrictions of plant importations. Advice to the Plant Quarantine Inspector was given on the nature of imported diseased plants which were intercepted by him. Very close study and consideration was given to the possibility of the introduction of cotton pests into the Island. For this reason the assistant was directed to make periodic inspections of the cotton fields in the Island. It was found that mildew which is causing little concern in other countries, is in Porto Rico a serious, if not the most serious, cotton disease so far. The causative agent of this disease, *Ramularia areola* Atk., thrives with greater vigor here than it does in other less humid climates. This forewarns against indiscriminate introduction of unsterilized seed and plants from other countries aside from the danger of introducing already existing and known serious pests. In observing the behavior of new introductions of tobacco varieties, cactus, Roselle (*Hibiscus sabdariffa*), field pea, and tomato it was observed that these plants become severely attacked with fungi which inhabit our soils but which are probably not present in the foreign soils from where the importations were made. *Phytophthora terrestria* was found to be the chief cause of the failure in the above-mentioned several plants. It was found associated with foot-rot of tobacco, Roselle, and grapefruit; with a fruit decay of tomato; and a pod rot of field pea. It is apparent that in attempting to introduce new varieties of plants here soil sterilization must be resorted to. The fact that the above-mentioned *Phytophthora* has been found capable of living on several known hosts makes it apparent that these susceptible crops should not be rotated on the same field.

The main topics under study were (1) a study of *Rhizoctonias* of Porto Rico (2), yellow-stripe disease of sugar-cane; (3) root disease of sugar-cane (4) and disease of the year.

These problems were mostly a continuation from the work begun the previous year.

The distinct types of the fungus *Rhizoctonia* were studied and determined, especially their relation to diseases of plants. A treatise on this subject will be published in the future.

One of the most important problems and one which took up a large part of the time in research was the yellow stripe disease of cane. The nature of this infectious disease as a result of experimental work and field observation, is now more clearly understood. There is now no doubt that it is an infectious disease caused by an undetermined organism. The results of the experiment on this problem were published in *The Journal of Department of Agriculture of Porto Rico,* Vol. 3, No. 4. The main points brought out were first that the disease is infectious and secondly that the infectious substance destroys the internal cells of the cane stalk and leaves. The presence of a foreign plasmodium-like substance in groups of cells in the interior of diseased cane stalks was demonstrated. This constitutes a new diagnostic feature, of the disease and adds a great deal to the understanding of the nature of the disease itself. From observations made in the field it is clear that the disease can be held in check by eradication and seed selection.

Root disease of sugar-cane was studied. A new organism described by the writer in the *Journal of the Department of Agriculture of Porto Rico,* Vol. IV, No. 1. as *Plasmodiophora vascularum* was discovered inhabiting the vascular bundles of stunted cane. A survey of the Island was made to determine the distribution of this organism, which is apparently an important factor in cane production. This organism was found in places where cane is known to suffer from "root disease." It was found at Mayagüez, San Germán district, Cayey, Río Piedras, Bayamón and Loíza in fields where the stand of cane was decidedly poor. The discovery of this organism is, an addition to our knowledge of root fungi and their relation to cane growth.

Among the most important diseases of the year considerable time was given to the study of gumming of sugar-cane. This disease was discovered for the first time in this Island during the last cane-cutting season. Several trips to ascertain the distribution of the disease were made. The exact locations of its occurrence were determined and a study was made of its susceptibility to the different cane varieties grown here. The organism, *Bacterium vascularum,* the cause of this disease, was isolated, and by inoculation trial an attempt was made to find resistant varieties of cane to this disease. Circular No. 20 was written on this subject.

Banana wilt was studied in a similar way. Circular No. 25 was written giving the salient features of this disease.

A new tobacco disease, caused by *Phytophthora terrestria,* was observed. This organism associated with this disease was isolated and identified. Experimental work on this disease is under way. The disease comes from infected soils, and it attacks the tomato, field pea, also Roselle. It is interesting to note the wide range of hosts that this organism is able to parasitize.

A pepper disease was observed. *Pythium* sp. was isolated from the diseased plants.

Sclerotium griseum, a fungus commonly found on dead sugarcane leaves was found to cause root decay and leaf injury to young cane plants.

Among the citrus diseases, foot-rot was given closer attention. *Phytophthora terrestria* was found in the diseased lesions of grapefruit trunks. A study was made on the resistance of grapefruit stock to foot rot. Coffee *Pellicularia* was successfully grown in pure culture from the young growth of this fungus on the underside of coffee leaves. This point suggests that in attempting to control the disease a spray treatment when employed should reach especially the underside of the foliage.

Observations were made on other coffee diseases including black root-rot.

Determinations of diseased plants were made for the subinspectors, the plant quarantine service and farmers. A considerable part of the time during the year was spent in visits to fields and plantations in the Island. Several special trips were made to investigate reported outbreaks of disease, and practically in every case of special call the nature of the trouble was diagnosed.

Due to limited space only a comparatively small number of specimens were added to our Herbarium.

ANNUAL REPORT FOR THE YEAR 1919–1920.

By Dr. Jaime Bagué, Veterinary Inspector.

CATTLE TICK ERADICATION.

History.—In November, 1918, in the Agricultural Congress held at Mayagüez under the auspices of the College of Agriculture, the Food Commission, the Federal Experiment Station and the Department of Agriculture and Labor, the writer addressed the audience on the subject of Tick Eradication. Previous to this talk we had opportunity to work out practical tests in the vat constructed by the Entomological Division of the Federal Station at Mayagüez. The talk was followed by a practical demonstration which closed the proceedings of the congress.

During the ensuing summer the Food Commission, through its Division of Agriculture, engaged the services of the writer to deliver a series of lectures throughout the Island. Every town was visited and 3,000 farmers attended the lectures. It was planned to work the idea in cooperation; but it failed and the local boards appointed did not take care of the work.

The next step on the subject was taken when the Legislature placed $15,000 on the budget of the Insular Experiment Station of the Department of Agriculture and Labor with the purpose of conducting a campaign against the cattle tick.

Work of the Insular Experiment Station.—In July, 1919, the necessary personnel was put in charge of the work and plans were drawn to start the field work.

After a survey of the whole field it was found that due to the work done by the agents of the Food Commission there were twenty-two vats working in the Island, four of them being in the town of Corozal.

The first step taken was to write Circular No. 18 in popular language and for free distribution. This circular is illustrated and embodies information on the habits of the cattle tick, the methods of eradication and the construction of vats.

Taking into consideration the fact that chemicals were needed and were cheaply needed, we started to stimulate the introduction

of the particular chemicals necessary for this work. With this purpose in view we called on some merchants who deal in fertilizers and farmers' supplies and to them we explained the idea. At the present time it is an easy matter to obtain the materials when needed. For the Government-owned vats we ordered enough chemicals to last a year.

As soon as the preliminary steps were over we started to call on the farmers and stock men of the Island. During seven months we visited thirty-six towns and travelled over 3,717.5 kilometers. This work brought us in contact with the people and we were able to find out their objections to the matter and to fight them on the spot.

TABLE No. I.

Towns Visited on Tick-Eradication Campaign from July 1, 1919, to February 29, 1920.

Arecibo	Ciales	Mayagüez	San Sebastián
Aguadilla	Caguas	Morovis	Toa Baja
Añasco	Coamo	Maricao	Toa Alta
Bayamón	Dorado	Naranjito	Vega Baja
Barceloneta	Fajardo	Naguabo	Vieques
Carolina	Guaynabo	Ponce	Yabucoa
Canóvanas	Humacao	Quebradillas	
Comerío	Isabela	Rincón	
Corozal	Las Marías	Río Grande	

Many towns were visited three and four times.

As a result of these personal talks and the concerted efforts of the subinspectors of agriculture we were able to raise the number of vats built to forty-three.

TABLE No. II.

Dipping Vats Working in Porto Rico on February 29, 1920.

	Owner	Town	Ward	Date of construction
1.	Ramón Avila	* Quebradillas	Cacao	Marzo 29, 1919.
2.	José Arrache	* Aguadilla		
3.	Jaime Abrams	* Isabela	Guayabo	Febrero 10, 1919.
4.	Bou Hnos.	* Corozal	Cibuco	Marzo 14, 1919.
5.	Russel & Cía	* Ponce	Hda. Fortuna	
6.	Russel & Cía	* Juana Díaz	Hda. Cristina	
7.	José Cestero	Guaynabo	Pueblo Viejo	Septiembre, 1919.
8.	Angel Cestero	Bayamón	Guaraguao	Octubre, 1919.
9.	Fededal Experiment Station	Mayagüez	Miradero	Septiembre, 1917.
10.	Jerónimo Fonalleda	Río Piedras	Las Monjas	Septiembre, 1919.
11.	Russel & Cía	* Yauco		
12.	Pedro Hernández	* Aguadilla		
13.	González & Calderón	Río Grande		Agosto, 1919.
14.	José Hernández	Dorado		Id.
15.	Domingo Luiña	* Bayamón		Enero, 1919.
16.	Enrique Landrón	* Arecibo		Marzo, 1919.
17.	Tomás Loydi	* Corozal		Id.
18.	Márquez Hnos.	Arecibo		Septiembre, 1919.
19.	Sucrs. José M. Ortiz	* Humacao		
20.	Pintueles & Cía.	Ciales		
21.	Delfín Ramírez	* Cabo Rojo		Octubre, 1919.
22.	Emeterio Ramírez	* Cabo Rojo		
23.	José Ruíz Soler	* Carolina		Febrero, 1918.
24.	San Feliz & Cía.	* Corozal		Id.
25.	Sucrs. Serrallés	* Juana Díaz		
26.	Juan Tinaud	Río Piedras		Octubre, 1919.
27.	Angel Umpierre	Bayamón		Junio, 1919.
28.	A. Biascochea	San Juan		Id.
29.	Estación Experimental Ins.	Río Piedras		Julio, 1918.
30.	Valiente y Cía.	* Corozal		Agosto, 1919.
31.	Ricardo Vela	Bayamón		Octubre, 1919.
32.	Angel Viejo	Bayamón		Marzo, 1919.
33.	San Miguel & Cía.	* Bayamón		Id.
34.	Russel & Cía.	* Ponce		Noviembre, 1919.
35.	Vicente Amador	Isabela		Id.
36.	José Barroso	Bayamón		Id.
37.	Angel Cestero	Dorado		Julio, 1919.
38.	Rafael Arroyo	Morovis		Febrero, 1920.
39.	José M. Pesquera	Bayamón		Id.
40.	José M. Pesquera	Toa Alta		Id.
41.	Municipio de	Trujillo Alto		Id.
42.	Lorenzo Oliver	Arecibo		
43.	Dept. de Agric. de P. R.	Vieques		Id.

* Vat built before the campaign started.

Number of pre-campaign vats	21
Vats built after July 1, 1919	22
Total number of vats working February 20	43

Dipping vats owned by the Federal Government	1
Dipping vats owned by the Insular Government	2
Dipping vats owned by the municipalities	1
Dipping vats owned by private persons and corporations	39
Total of vats	43
Number of towns in which there are vats	23

In order to keep in contact with the farmers we prepared postal cards and a set of books to keep the statistics of the animals dipped each month in each municipality. In these cards the owners give the number of head of cattle under treatment and they are placed on our files. On that account we are able to give the data in the table below:

TABLE No. III.

Units Treated in the Dipping Vats of the Island from July 1, 1919, to February 29, 1920.

Municipality	Oxen	Cows	Yearlings	Calves	Other animals	Total
Aguadilla	16	3	7	2		28
Arecibo	290	40	46	42	19	437
Bayamón	929	746	687	519	101	2,982
Cabo Rojo	102	30	9	24		165
Carolina		413	249	252		914
Ciales	30	37	55	37	14	173
Corozal	235	279	313	191	30	1,048
Dorado	120	19		17		156
Guaynabo	30	110	20	50		210
Humacao	815	45	21	40		921
Isabela	225	186	199	74	47	731
Ponce	1,765					1,765
Juana Díaz	2,509	331	613	264		3,807
Mayagüez	224	293	132	145		794
Quebradillas	176	245	172	240		833
Río Grande	450	410	25	345		1,230
Río Piedras	319	326	288	220		1,153
Vieques	54			4	4	62
Total	8,379	3,513	2,836	2,466	215	17,409

Periodically the people who owned vats and those who were interested in the matter received mimeograph copies of the latest reports of the results obtained by the more progressive farmers.

It was our intention to take an agricultural extension train through the Island, but this was postponed on account of the railroad strike. When it was stated that the Red Cross and the "Federa-

ción Portorrequeña" were planning to hold fairs at San Juan and Bayamón the idea was entirely dropped. Arrangements were under way and the American Railroad Company was going to provide cars free of charge.

On November 18, 1919, the first Government-owned vat was opened for business in the grounds of the Insular Experiment Station at Río Piedras. On the 6th of February another Government-owned vat was ready for work at Vieques.

These public vats had such a good effect on the campaign that it was recommended that the construction of a number of them be undertaken to be used as demonstration vats in every district. This idea was approved and acted upon.

The publicity end of the campaign was not overlooked. Small items were sent to the papers for publication, and a regular illustrated advertisement appeared in the daily press for a number of weeks.

On February 29, by order of the Commissioner of Agriculture, the work was turned over to Dr. Varas of the Bureau of Agriculture.

Summary of the work.—1. We were in charge of the cattle-tick eradication work from July, 1919, to February, 1920, or seven months.

2. We found twenty-two vats working.

3. When the work was turned over to the Bureau of Agriculture in February, 1920, there were forty-three vats on the Island.

4. The total of animals dipped during these seven months was 17,409 heads of live stock.

IMPORTATION OF PURE-BRED STOCK.

Swine.—With the money voted by the Legislature immediate steps were taken to obtain the swine. The first importation of pigs for this Station arrived in February, 1920, and the second in March of the same year. The herd consists of the following breeds: 2 male and 2 female Berkshires; 2 male and 2 female Red Duroc Jerseys, and one pair of the Tamworth.

The above-mentioned animals were carefully selected in the States, their herds were examined by competent veterinary inspectors, and the pedigrees carefully studied. The transfer of their registry papers was a prerequisite of the deal.

It is a fact that the Berkshires thrive well in this Island and all indications tend to show that the Red Duroc Jersey will also

stand the heat of the tropics. The Tamworth breed is a little more delicate than those already mentioned. These are not final conclusions, because we have not had time to finish our observations on the subject. Further details will be embodied in a publication of a scientific nature.

As soon as the animals reached the Station steps were taken to house and feed them. We are planning to have the pigs fed with concentrates and vegetables grown here. In this respect we have succeeded in getting them to eat the dry fruit of the Royal Palm.

As to housing, we built ten huts with a corresponding number of yards. These huts are movable and can be changed from one place to the other as is needed.

Goats.—Part of the money in the budget was for goats. We tried to introduce Saanean and Toggenburg specimens, but we could obtain only one pure-bred Toggenburg buck.

We are expecting to buy the females from last spring's kidding. The buck is being used by the public and is in good health.

This is a very important thing. We ought to have a goat dairy in order to be able to provide good goats and bucks for the farmer in order to increase the milk supply.

CONSULTATION AND ADVICE.

Nearly all the correspondence of this office consists of consultations from the farmers. The great bulk of it is purely veterinary work.

Agricultural Meetings.—During the year we have attended eight agricultural meetings with the purpose of delivering lectures dealing with live-stock subjects.

TABLE NO. IV.

WHERE LECTURES WERE DELIVERED.

November 1, 1919	Ciales.
January 18, 1920	Caguas.
January 31, 1920	Aguadilla.
February 8, 1930	Vieques.
February 29, 1920	Manatí.
March 7, 1920	Carolina.
May 22, 1920	Corozal.
June 19, 1920	Ciales.

Circulars and Press Notices.—The following publications were released by this office to the press:

Circular 18. Eradication of Ticks.
Circular 21. Hog Cholera.

A number of shorter articles were sent to the daily press dealing with tick eradication and the live-stock situation of Porto Rico.

Articles for La Revista.—

1. La Diarrea Blanca.
2. Peor que una Herida.
3. El Problema Pecuario—El Ganado Vacuno.
4. El Problema Pecuario—El Ganado Cabrío.
5. El Problema Pecuario—El Ganado de Cerda.
6. El Problema Pecuario—Un Programa a Seguir.

Museum.—We have started to collect pathological material with the purpose of forming a nucleus for a small museum.

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